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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE, COMMON SENSE AND DECENCY[1]

By Dr. IRVING LANGMUIR

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UP to the beginning of the present century one of the main goals of science was to discover natural laws. This was usually accomplished by making experiments under carefully controlled conditions and observing the results. Most experiments when repeated under identical conditions gave the same results.

The scientist, through his own experiments or from previous knowledge based on the work of others, usually developed some theory or explanation of the results of his experiments. In the beginning this might be a mere guess or hypothesis which he would proceed to test by new types of experiments. If a satisfactory theory is obtained which seems in accord with all the data and with other known facts, the solution or goal of the investigation was considered to have been reached.

A satisfactory theory should make possible the predictions of new relationships or the forecasting of the results of new experiments under different conditions. The usefulness of the theory lies just in its ability to predict the results of future experiments. The extraordinary accomplishments of the great mathematical physicists in applying Newton's Laws to the

[1] Address of the retiring president of the American Association for the Advancement of Science. Owing to the postponement of the New York meeting, at the request of the Office of Defense Transportation, the address was broadcast by Science Service over the Columbia Broadcasting System on December 26, 1942.

motions of the heavenly bodies gave scientists of more than a century ago the conviction that all natural phenomena were determined by accurate relations between cause and effect. If the positions, the velocities and the masses of the heavenly bodies were given it was possible to predict with nearly unlimited accuracy the position of the bodies at any future time. The idea of causation, or a necessary relation of cause and effect, has long been embedded in the minds of men. The recognized responsibility of the criminal for his acts, the belief of the value of education and thousands of words in our language all show how implicitly we believe in cause and effect. The teachings of classical science, that is, the science up to 1900, all seem to reinforce this idea of causation for all phenomena.

Philosophers, considering many fields other than science, were divided in their opinions. Many went so far as to believe that everything was absolutely fixed by the initial conditions of the universe and that free will or choice was impossible. Others thought that cause and effect relations were mere illusions.

From the viewpoint of the early classical scientist the proper field for science was unlimited. Given sufficient knowledge, all natural phenomena, even human affairs, could be predicted with certainty. Ampere, for example, stated that if he were given the positions and velocities of all the atoms in the universe it should be possible theoretically to determine the whole future history of the universe. Practically, of course, such predictions would be impossible because we could never hope to get the necessary knowledge nor the time to carry out such elaborate calculations.

A little later scientists developed the kinetic theory of gases according to which the molecules of a gas are moving with high velocity and are continually colliding with one another. They found that the behavior of gases could be understood only by considering the average motions of the individual molecules. The particular motion of a single molecule was of practically no importance. They were thus taught the value of statistical methods, like those which the insurance company now uses to calculate the probable number of its policy-holders that will die within a year.

The theories or explanations which were developed in connection with the natural laws usually involved a description in terms of some kind of a model. In general, instead of thinking of the whole complex world we select only a few elements which we think to be important and concentrate our minds on these. Thus, the chemist developed the atomic theory according to which matter was made up of atoms of as many different kinds as there are chemical elements. These were thought of as small spheres, but no thought was given as to the material of which they were made. When later theories indicated that these atoms were built up of electrons and positive nuclei this made very little difference to the chemist, for he had not needed previously to consider that aspect of the model.

High-school boys to-day are asked to build model airplanes. These must be of such shape that the different types of airplanes can be recognized when the profiles of the models are seen against a white background. It naturally is not particularly important just what kind of material is used in constructing them. Airplane designers build model airplanes to be studied in wind tunnels, but these do not need to be provided with motors.

Most of the models which the scientist uses are purely mental models. Thus, when Maxwell developed the electromagnetic theory by which he explained the properties of light he thought of a medium through which these waves traveled. This was called the ether. It was supposed to have properties like those of elastic solid bodies. The reason for this choice of a model was that at that time the average scientist had been taught in great detail the theory of elasticity of solid bodies. Thus the magnetic and electric fields could be understood in terms of the familiar elastic properties. At the present time relatively few students are well trained in the theories of elasticity. The situation is thus reversed and to-day we explain the properties of elastic solids in terms of the electrical forces acting between their atoms.

Every student of geometry constructs a mental model when he thinks of a triangle. The mathematical lines that bound the triangle are supposed to have no thickness. In other words, they are stripped of any properties except those that we wish particularly to consider.

Most of the laws of physics are stated in mathematical terms, but a mathematical equation itself is a kind of model. We establish or assume some correspondence between things that we measure and the symbols that are used in an equation, and then, after solving the equation so as to obtain a new relation, we see if we can establish a similar correspondence between the new relation and the experimental data obtained from the experiment. If we succeed in this we have demonstrated the power of the mathematical equation to predict events.

The essential characteristic of a model is that it shall resemble in certain desired features the situation that we are considering. On this basis we should recognize that practically any theory has many arbitrary features and has limitations and restrictions imposed by the simplifications that we have made in the development of the theory or the construction of our model.

Beginning with Einstein's relativity theory and Planck's quantum theory a revolution in physical

thought has swept through science. Perhaps the most important aspect of this is that the scientist has ceased to believe that words or concepts can have any absolute meaning. He is not often concerned with questions of existence; he does not know what is the meaning of the question, "Does an atom really exist?" The definition of "atom" is only partly given in the dictionary. Its real meaning lies in the sum total of knowledge on this subject among scientists who have specialized in this field. No one has been authorized to make an exact definition. Furthermore, we can not be sure just what we mean even by the word "exist." Such questions are largely metaphysical and in general do not interest the modern scientist. Bridgman has pointed out that all concepts in science have value only in so far as they can be described in terms of operations or specifications. Thus it doesn't mean much to talk about length or time unless we agree upon the methods by which we are to measure length and time.

For many years, up to about 1930, the new physics based on the quantum theory seemed to be fundamentally irreconcilable with the classical physics of the previous century. Through the more recent development of the uncertainty principle, developed by Bohr and Heisenberg, this conflict has now disappeared. According to this principle it is fundamentally impossible to measure accurately both the velocity and the position of any single elementary particle. It would be possible to measure one or the other accurately but not both simultaneously. Thus it becomes impossible to predict with certainty the movement of a single particle. Therefore, Ampere's estimate of the scope of science has lost its basis.

According to the uncertainty principle, which is now thoroughly well established, the most that can be said about the future motion of any single atom or electron is that it has a definite probability of acting in any given way. Probability thus becomes a fundamental factor in every elementary process. By changing the conditions of the environment of a given atom, as, for example, by changing the force acting on it, we can change these probabilities. In many cases the probability can be made so great that a given result will be almost certain. But in many important cases the uncertainty becomes the dominating feature just as it is in the tossing of a coin.

The net result of the modern principles of physics has been to wipe out almost completely the dogma of causation.

How is it, then, that classical physics has led to such definite clean-cut laws? The simplest answer is that the classical physicist naturally chose as the subjects for his studies those fields which promised greatest success. The aim of the scientist in general was to discover natural laws. He therefore carried on his experiments in such a way as to find the natural laws, for that is what he was looking for. He was best able to accomplish this by working with phenomena which depended upon the behavior of enormous numbers of atoms rather than upon individual atoms. In this way the effects produced by individual atoms averaged out and became imperceptible. We have many familiar examples of this effect of averaging—the deaths of individual human beings can not usually be predicted, but the average death rate in any age group is found to come close to expectation.

Since the discovery of the electron and the quantum and methods of detecting or even counting individual atoms, it has been possible for scientists to undertake investigations of the behavior of single atoms. Here they have found unmistakable experimental evidence that these phenomena depend upon the laws of probability and that they are just as unpredictable in detail as the next throw of a coin. If, however, we were dealing with large numbers of such atoms the behavior of the whole group would be definitely determined by the probability of the individual occurrence and therefore would appear to be governed by laws of cause and effect.

Just as there are two types of physics, classical physics and quantum physics, which have for nearly twenty-five years seemed irreconcilable, just so must we recognize two types of natural phenomena. First, those in which the behavior of the system can be determined from the average behavior of its component parts and second, those in which a single discontinuous event (which may depend upon a single quantum change) becomes magnified in its effect so that the behavior of the whole aggregate does depend upon something that started from a small beginning. The first class of phenomena I want to call *convergent phenomena,* because all the fluctuating details of the individual atoms average out giving a result that converges to a definite state. The second class we may call *divergent phenomena,* where from a small beginning increasingly large effects are produced. In general then we may say that classical physics applies satisfactorily to convergent phenomena and that they conform well to the older ideas of cause and effect. The divergent phenomena on the other hand can best be understood on the basis of quantum theory of modern physics.

Let me give some illustrations of divergent phenomena. The wonderful cloud chamber experiments of C. T. R. Wilson show that a single high-speed electron or an alpha particle from an atom of radium, in passing through a gas, leaves a trail of ions. By having moisture in the gas and by causing the gas to expand just after these ions are produced, drops of water are made to condense on the ions. By a strong illumination it thus becomes possible to see or photo-

graph this track of ions as a white line on a dark background. The time at which an alpha particle will be emitted from a radium atom is inherently unpredictable. It would be totally contrary to the teachings of modern physics to suppose that our inability to predict when such an event is merely due to our ignorance of the conditions surrounding the particular atom. The uncertainty principle requires that even if these conditions were absolutely fixed the time of emission and the direction of emission of the alpha particle are subject to the laws of chance and thus for a single particle are unpredictable.

The occurrences in the Wilson cloud chamber following the disintegration of a single radium atom are typical divergent phenomena. The single quantum event led to the production of countless thousands of water droplets and these made the track of the alpha particle visible and led to its reproduction in a photograph. This track may show some unusual feature of particular interest to the scientist; for example, it may have a kink which indicates that the alpha particle collided with the nucleus in one of the molecules of gas. The photograph may therefore be published —may start discussions among scientists that involve thousands of man hours—may delay one of them so that he misses a train on which he might otherwise have suffered a fatal accident. Examples of this kind, any number of which could be given, show that it is possible for single unpredictable quantum events to alter the course of human history.

The formation of crystals on cooling a liquid involves the formation of nuclei or crystallization centers that must originate from discrete, atomic phenomena. The spontaneous formation of these nuclei often depends upon chance.

At a camp at Lake George, in winter, I have often found that a pail of water is unfrozen in the morning after being in a room far below freezing, but it suddenly turns to slush upon being lifted from the floor.

Glycerine is commonly known as a viscous liquid, even at low temperatures. Yet if crystals are once formed they melt only at 64° F. If a minute crystal of this kind is introduced into pure glycerine at temperatures below 64° the entire liquid gradually solidifies.

During a whole winter in Schenectady I left several small bottles of glycerine outdoors and I kept the lower ends of test-tubes containing glycerine in liquid air for days, but in no case did crystals form.

My brother, A. C. Langmuir, visited a glycerine refinery in Canada which had operated for many years without ever having any experience with crystalline glycerine. But suddenly one winter, without exceptionally low temperatures, the pipes carrying the glycerine from one piece of apparatus to another froze up. The whole plant and even the dust on the ground became contaminated with nuclei and although any part of the plant could be temporarily freed from crystals by heating above 64° it was found that whenever the temperature anywhere fell below 64° crystals would begin forming. The whole plant had to be shut down for months until outdoor temperatures rose above 64°.

Here we have an example of an inherently unpredictable divergent phenomenon that profoundly affected human lives.

Every thunderstorm or tornado must start from a small beginning and at least the details of the irregular courses of such storms across the country would be modified by single quantum phenomena that acted during the initial stages. Yet small details such as the place where lightning strikes or damage occurs from a tornado may be important to a human being.

Much more obvious examples of divergent phenomena which affect human life are those involved in the mechanism of heredity and the origin of species. Whether the genes are inherited from the mother or from the father seems to be fundamentally a matter of chance, undoubtedly involving changes in single atoms. It is known definitely that changes in genes or mutations can be produced by x-rays, and it has even been proved that a single quantum is sufficient to bring about such an alteration. The growth of any animal from a single cell is a typical illustration of a divergent phenomenon. The origins of species and all evolutionary processes, involving as they do natural selection acting upon mutations, must depend at almost every stage upon phenomena which originate in single atoms.

An idea that develops in a human brain seems to have all the characteristics of divergent phenomena. All through our lives we are confronted with situations where we must make a choice and this choice may sometimes alter the whole future course of our lives. Occasionally such decisions are made by tossing a coin —an event which seems unpredictable—but there is no reason to doubt that single atomic processes, or small groups of them which follow statistical laws, may not often be a determining element.

When certain bacteria are heated until they begin to die it is found that in successive intervals of time the same fraction of the survivors succumb. This seems to prove that the life of these cells depends on a single unstable molecule whose change involves death. It is thus a matter of pure chance as to which particular individuals die within a given period.

The examples that I have given of convergent and of divergent phenomena are purposely chosen as extreme types. Actually there are many intermediate cases that are not clearly one or the other. Or, again, phenomena which start out to be divergent may ap-

parently degenerate into the convergent type. For example, if the photograph of the Wilson cloud track did not prove to be of interest it would soon be forgotten and might have no further ascertainable effects on human lives. Similarly in the evolutionary process a new species that originates as a single divergent omenon may not survive and its effect soon seems e out.

must recognize, nevertheless, that a divergent omenon which once occurs permanently alters s of molecular arrangements in the convergent ns that follow it and thus conditions may be brought about which favor the occurrence of new divergent phenomena. In a world in which divergent or quantum phenomena occur we can thus have no absolute relation of cause and effect.

As the implications of the uncertainty principle, especially as applied to divergent phenomena, are more generally recognized the limitation of the idea of causality should have profound effects on our habits of thought. The science of logic itself is involved in these changes. Two of the fundamental postulates of logic are known as the law of uniformity of nature and the law of the excluded middle. The first of these laws is equivalent of the postulate of causality in nature. The second law is simply the familiar postulate that a given proposition must be either true or false. In the past these so-called laws have formed the basis of much of our reasoning. It seems to me, however, that they play no important part in the progress of modern science. The cause and effect postulate is only applicable to convergent phenomena. The second postulate in assuming that any proposition must be true or false implies that we attach absolute meanings to words or concepts. If concepts have meanings only in terms of the operations used to define them we can see that they are necessarily fuzzy. Take, for example, this statement, "Atoms are indestructible." Is this true or false? The answer depends upon what aspect of atoms is considered. To the chemist the statement is as true as it ever was. But a physicist, studying radioactive changes, recognized that some atoms undergo spontaneous disintegration or destruction. The fact is that the chemist and the physicist have no exact definitions of the word "atom" and they also do not know in any absolute sense what they mean by "indestructible."

Fortunately such questions no longer occupy much of the time of scientists, who are usually concerned with more concrete problems which they endeavor to treat in common-sense ways.

It is often thought by the layman, and many of those who are working in so-called social sciences, that the field of science should be unlimited, that reason should take the place of intuition, that realism should replace emotions and that morality is of value only so far as it can be justified by analytical reasoning.

Human affairs are characterized by a complexity of a far higher order than that encountered ordinarily in the field of science.

To avoid alternating periods of depression and prosperity economists propose to change our laws. They reason that such a change would eliminate the cause of the depressions. They endeavor to develop a science of economics by which sound solutions to such problems can be reached.

I believe the field of application of science in such problems is extremely limited. A scientist has to define his problem and usually has to bring about simplified conditions for his experiments which exclude undesired factors. So the economist has to invent an "economic man" who always does the thing expected of him. No two economists would agree exactly upon the characteristics of this hypothetical man and any conclusions drawn as to his behavior are of doubtful application to actual cases involving human beings. There is no logical scientific method for determining just how one can formulate such a problem or what factors one must exclude. It really comes down to a matter of common sense or good judgment. All too often wishful thinking determines the formulation of the problem. Thus, even if scientifically logical processes are applied to the problem, the results may have no greater validity than that of the good or bad judgment involved in the original assumptions.

Some of the difficulties involved in a scientific approach to economic problems is illustrated by the following: If we wish to analyze the cause of a depression (or for example, a war) we should ask ourselves what we mean by the word "cause" in this connection. In terms of operations the usual meaning of the word cause is something as follows: It is a common experience, in a study of convergent phenomena, that if a given set of physical conditions are brought about repeatedly at different times, the same result occurs in each case. Except in so far as it is possible to repeat the experiment and get the same result it is impossible to give a definite meaning to the word cause.

In the case of a depression or a war, we logically need to produce, or at least to observe, a given set of possible antecedent conditions and to see whether they are always followed by depressions. Since we can not produce experimental depressions, nor have we sufficient observational data to enable us by statistical means to unravel the enormous number of factors involved, we must conclude that the word "cause" as applied to a depression has an extremely fuzzy meaning.

When we consider the nature of human affairs it is to me obvious that divergent phenomena frequently

play a role of vital importance. It is true that some of our historians cynically taught most of our college students from 1925 to 1938 that wars, the rise and fall of a nation, etc., were determined by nearly cosmic causes. They tried to show that economic pressure, and power politics on the part of England or France, etc., would have brought the same result whether or not Kaiser Wilhelm or Hitler or any other individual or group of individuals had or had not acted the way they did. Germany, facing the world in a realistic way, was proved, almost scientifically, to be justified in using ruthless methods—because of the energy and other characteristics of the German people they would necessarily acquire and should acquire a place in the sun greater than that of England, which was already inevitably on the downward path.

I can see no justification whatever for such teaching that science proves that general causes (convergent phenomena) dominate in human affairs over the results of individual action (divergent phenomena). It is true that it is not possible to prove one way or the other that human affairs are determined primarily by convergent phenomena. The very existence of divergent phenomena almost precludes the possibility of such proof.

The mistaken over-emphasis on convergent phenomena in human affairs and the reliance on so-called scientific methods have been responsible in large degree for much of the cynicism of the last few decades.

The philosophy which seems to have made the German people such willing aggressors is allegedly based upon scientific realism. Almost any system of morality or immorality could receive support from the writings of Nietzsche, so inconsistent are they with one another. But his teachings, which purport to be based on the laws of natural selection, have led in Germany to a glorification of brute strength, with the elimination of sympathy, love, toleration and all existing altruistic emotions.

Darwin, himself, however, recognized that the higher social, moral and spiritual developments of mankind were factors which aided in survival. This is often referred to loosely as the law of the survival of the fittest. The concept of fitness seems, however, inherently rather fuzzy. Apparently those individuals are fittest which possess characteristics that increase the probability that they shall survive.

We often hear realists deplore the effects of charity which tend to keep the unfit alive. We are even told that the whole course of evolution may be revised in this way. Similar arguments could be used against the surgeon who removes an appendix or a doctor who uses a sulfa drug to cure pneumonia.

But what is the need of developing a race immune to appendicitis or pneumonia if we possess means for preventing their ill effects. The characteristics that determine fitness merely change from those of immunity to those which determine whether a race is able to provide good medical treatment.

The coming victory of the United Nations will prove that survival of a nation may be prevented by an aggressive spirit, by a desire to conquer or enslave the world, or by intolerance, ruthlessness and cruelty. In fact, there is no scientific reason why decency and morality may not prove to be vastly more important factors in survival than brute strength.

In spite of the fact that we can no longer justify a belief in absolute causation and must recognize the great importance of divergent phenomena in human life we still have to deal with causes and effects. After all we must plan for the future. We can do this, however, by estimating probabilities even where we do not believe that definite results will inevitably follow. When our army lands in North Africa its probable success depends on the carefulness of the preparations and the quality of the strategy. But no amount of foresight can render success absolutely certain.

It does not seem to me that we need be discouraged if science is not capable of solving all problems even in the distant future. I see no objections to recognizing that the field of science is limited.

In the complicated situations of life we have to solve numerous problems and make many decisions. It is absurd to think that reason should be our guide in all cases. Reason is too slow and too difficult. We do not have the necessary data or we can not simplify our problem sufficiently to apply the methods of reasoning. What then must we do? Why not do what the human race always has done—use the abilities we have—use common sense, judgment and experience. We under-rate the importance of intuition.

In almost every scientific problem which I have succeeded in solving, even after those that have taken days or months of work, the final solution has come to my mind in a fraction of a second by a process which is not consciously one of reasoning. Such intuitive ideas are often wrong. The good must be weeded out from the bad—sometimes by common sense or judgment—other times by reasoning. The power of the human mind is far more remarkable than one ordinarily thinks. We can often size up a situation, or judge the character of a man by the expression of his face or by his acts in a way that would be quite impossible to describe in words.

People differ greatly in their ability to reach correct conclusions by such methods. Our numerous superstitions and the present popularity of astrology prove how often our minds make blunders. Since we have to live with our minds, we should train them, develop them, censor them—but let us not restrict them by trying to regulate our lives solely by science or by reason.

Our morality is a kind of summation of the wisdom and experience of our race. It comes to us largely by tradition or religion. Some people justify evil things on the basis of morality—but by and large a recognition of right and wrong, even if these concepts are sometimes fuzzy, has proved to be of value to mankind. The philosophical, metaphysical or even scientific analysis of the principles of ethics has not proved particularly fruitful. A sense of morality and decency, even if not scientific, may help win the war.

THE AMERICAN ETHNOLOGICAL SOCIETY[1]

By the late Dr. FRANZ BOAS

PROFESSOR EMERITUS OF ANTHROPOLOGY, COLUMBIA UNIVERSITY

THE American Ethnological Society was founded at a period when interest in racial and ethnic questions was very lively. The racial question was particularly a subject of heated discussion on account of the struggle between the abolitionists and the defendants of slavery. It had taken the form of a passionate controversy between those who stood for the unity of mankind and those who claimed distinct origins for the races of man. At the same time the interest in the customs and lives of alien people was very lively. It was about the time of the Wilkes expedition to the South Seas, of the vast collection of material on the American Indians by Schoolcraft and of intensive interest in the archeology of our continent.

Through the energy and interest of Albert Gallatin the American Ethnological Society was established and during the years from 1842 until his death in 1849 the society was a center of anthropological interest in New York City. About the same time the Government explorations of the western part of the United States gave strong stimulus to interest in the study of Indian tribes and of American antiquities. For a number of years the society contributed in important ways to our knowledge of both North and Central America. The investigations of members of the society were published in the form of Transactions, of which three volumes appeared, in 1845, 1848 and 1853. The last one of these volumes was never published because the whole edition was destroyed by fire before it was distributed. It was, however, republished in photographic reproduction in 1909 by the revived society. A new start was made in 1860 when the society began publication of a bulletin containing brief communications, the last of which appeared in 1869. The interest of members in the society was evidently declining rapidly and in 1869 a committee headed by E. George Squier issued a statement calling for reorganization on a new basis. The outlook of this group is characterized by the following statement issued in 1869, evidently drafted by Mr. Squier:

> Statesmen, whether senators or kings, can no longer overlook the profound lessons inculcated by anthropology. The political reorganization of Europe is going on in consonance with its discoveries and results. Religion under its influence is separating itself from a ritualistic dogmatism that has nothing to do with morals or the relationship that exists between men and God and has become all the loftier from the dissociation.
>
> To these grand results we may ask what has the American Ethnological Society contributed. Absolutely, for twenty years, nothing. True, ten of these years have been unfavorable to scientific pursuits in this country. Students having common sympathies and aims have been separated by political and social barriers and investigators weaned or diverted from their pursuits by imperative requirements in other fields. Estranged co-laborers, however, are returning with that catholic spirit which study for Truth inspires and encourages, to their old associations and researches; and the altered condition of our common country encourages and, indeed, makes necessary a wider and deeper investigation of the character and true relations of the varieties and races of mankind than ever existed before. But this investigation must be made *ab initio*, or rather in a purely abstract scientific sense. It can not be done by men who, for any reason or motive, bring into the study the element of faith, or adhesion to dogmas or creeds of any kind whatever. These subtle elements of depression of scientific inquiry have been, to a certain degree, the ruin of this Society. Your reporter can remember when the question of human unity could not be discussed without offense to some of the members of the Society and when its casual introduction was made a ground of impassioned protest. This allusion is made only to enforce the vital truth that, in scientific inquiry, the item of faith must be entirely eliminated. Not having been so, discussion in this Society has been relatively tame and fruitless.

On the basis of this critical examination of the activities of the society during the two decades from 1850 to 1869, the American Ethnological Society was dissolved and it was decided to reconstitute the society as the American Anthropological Society. Since at the same time an association with the same name had been founded in Boston, the committee followed the example of the newly consolidated Anthropological and Ethnological Societies of London and adopted the name "The Anthropological Institute of New

[1] Address delivered at the celebration of the centenary of the society, on November 14, 1942. Dr. Boas died on December 21.

York," which published its first volume in 1871–1872. The object of the newly organized group was stated as "the study of man in all his varieties and under all his aspects and relations."

This attempt at reorganization was evidently unsuccessful. An association of the old members of the Ethnological Society with the newly founded American Museum of Natural History led to a formal continuance of activities under the old name of the American Ethnological Society, but there was evidently no productive scientific activity during this period.

About 1895, when the American Museum of Natural History began its field explorations and when anthropology was introduced as a subject of instruction in Columbia University, a number of younger men were drawn to New York who met occasionally in an informal way to discuss anthropological problems. The first attempts to affiliate this group with the surviving members of the American Ethnological Society were unsuccessful because the society had practically become a group which met occasionally for social purposes. As the American Museum of Natural History developed, the proposal of reactivating the American Ethnological Society was renewed. In 1900 the younger group joined the society, and the president of the American Museum of Natural History, Morris K. Jesup, was elected president of the society. He was succeeded by General James Grant Wilson, who served until 1913. After this time the officers of the society were confined entirely to professional anthropologists.

About this time cooperation of the scientific societies of New York was established under the leadership of the New York Academy of Sciences. The Ethnological Society joined this organization and since that time its regular meetings have been held in connection with the meetings of the New York Academy of Sciences at the American Museum of Natural History.

With the renewal of the activities of the society it was felt that the most important service that could be rendered was to establish a series of publications and the society became essentially a publishing society, although regular meetings were held, without however any attempt to publish these in the form of transactions. The meetings were on the whole rather informal and devoted to questions on which the members of the society or visiting anthropologists were working.

It was a period of a general reorganization of anthropological societies. Long before this time anthropology had been recognized as one of the sections of the American Association for the Advancement of Science, and in the annual meetings anthropologists from all parts of the country used to meet and to discuss their problems. About the same time an anthropological society was founded in Washington, curiously enough followed by the establishment of a women's anthropological society in the same city. On account of the difficulties of publication it was felt that a general anthropological society was needed an at the time of the meeting of the American Association for the Advancement of Science in Pittsburgh in 1902, the establishment of the American Anthropological Association was decided upon. The difficult financial question of establishing an adequate journal for the publication of work of American anthropologists was met by the generosity of Charles P. Bowditch of Boston and the Duke of Loubat of New York, who helped the journal during the early years of its existence. At the same time an agreement was reached between the American Anthropological Association and the American Ethnological Society for a certain division of the kind of publication to be maintained by either society. The *American Anthropologist* was established as the joint journal of both societies. While the *American Anthropologist* was to contain papers on general anthropology the Ethnological Society confined its publication to a series of volumes giving ethnological records of various tribes in the original language with translations, thus following the earlier series published by the U. S. Geological and Geographical Survey of the Rocky Mountain Region and of the series of native documents published by Daniel Garrison Brinton.

During these years of specialization the *Journal of American Folk-Lore* had been established owing to the energetic efforts of William Wells Newell. In 1918, a special journal was established by Dr. Aleš Hrdlička for physical anthropology and the *International Journal of American Linguistics* by myself in 1917. In 1940 the American Ethnological Society started a new series of brief ethnographic monographs.

Thus the society has become an active member in anthropological work in our country. Let us hope that it will continue its active participation in anthropological work and contribute by the researches of its members and by its more popular activities to the solution of the difficult social problems of our times.

OBITUARY

JOHN FRANKLIN DANIEL

PROFESSOR JOHN FRANKLIN DANIEL, chairman of the department of zoology of the University of California, died in Berkeley on November 2, 1942. The students, colleagues, friends and family of Dr. Daniel assembled at his home on the afternoon of November

third for a brief service in memory of him and his long, fruitful life.

He was born on July 31, 1873, in O'Fallon, Missouri. His education beyond the secondary school was begun at Southern Illinois State Normal University. As he completed his second year of college the U. S. Government issued a call for teachers to go to the Philippine Islands. Daniel volunteered and was a member of the first group to be sent there. The four years in the Philippines (1901–1905) were among the most important of his life. It was probably here that he learned how to teach. His first pupils were the unsympathetic, unschooled natives, most of whom spoke no English; the facilities for instruction were meager; but by trial and error, instructor and pupil learned from each other. Before Daniel left the Archipelago he had become district superintendent of schools for the island of Cebu. The contribution of these early American teachers becomes more real and more significant as we observe the loyalty of the Philippine people to American ideals in the recent and tragic history.

The interruption in his formal education did not lessen Daniel's interest in zoology. The simple book on the animal life of Malaysia which he wrote while in the Philippines is good evidence. Serious study, however, was resumed at the University of Chicago, from which he received the bachelor's degree in 1906, and at Johns Hopkins University, where the doctorate was completed in 1908. The same year he married Menetta Brooks, daughter of William Keith Brooks. The following year was spent at the Pasteur Institute at Lille, France, where Daniel held the Adam T. Bruce fellowship. On returning to the United States he accepted an instructorship in zoology at the University of Michigan. In 1910 he joined the faculty in zoology at the University of California at Berkeley. Here he served for thirty-two years, the last six as chairman of the department. The honors which he prized most were his appointment as United States delegate to the International Congress of Zoology at Lisbon in 1935 and his decoration in 1936 by France as Chevalier of the Légion d'honneur.

Dr. Daniel contributed about equally in teaching, research and administration. Through his course in general chordate zoology, which he gave for many years, his influence was felt by hundreds of undergraduate students. The graduate students of the department and especially his own students are deeply indebted to him. From him they learned to appreciate the sacredness of character, the value of high scholarship, the importance of being a gentleman, the dignity of the teaching profession and the opportunities and responsibilities of a great university. From him they learned that industry is a privilege; that generosity and kindness are everlasting virtues; that truth is both an anchor and a compass.

Dr. Daniel's contributions in research were made in two fields: experimental morphogenesis and comparative anatomy. The subject of his doctoral work, carried out under the direction of Professor H. S. Jennings, was the "Adaptation and Immunity of Lower Organisms to Ethyl Alcohol." It was probably through this and an earlier study on the adjustment of *Paramecium* to distilled water that Dr. Daniel became devoted to the experimental method. A short paper appeared soon after his return from the Pasteur Institute at Lille on the length of the period of gestation in lactating and in primiparous mice. He demonstrated that females bearing young while suckling an older litter have a considerably longer period of gestation than those carrying their first litter. Had this line of inquiry been continued, Dr. Daniel might well have become an endocrinologist. However, in accepting an instructorship at the University of California his attention was turned to comparative anatomy in general and the elasmobranch fishes in particular. A series of papers on the morphology of these fishes culminated in his widely known monograph, "The Elasmobranch Fishes," published in 1922. His feeling for these creatures is beautifully expressed in the introduction to his book:

> There lives to-day a vast group of fishes, some of which are littoral, keeping close to shore; others are the nomads of the ocean, roaming vast expanses of its waters; others there are which are pelagic, living near its surface; and still others that are the inhabitants of the profound depths into which the sunlight never penetrates—these are the sharks, to the man with nets the most worthless, to the naturalist among the most interesting of living things.

The work on the elasmobranch fishes concluded his studies in the field of comparative anatomy except for two papers published later on the larval cyclostome, Ammocoetes; one of these, a report of the circulatory system, is a valuable supplement to his monograph on the elasmobranchs. Dr. Daniel's interest in experimental biology was revived by the discoveries of Spemann and a visit to Spemann's laboratory in 1929. The final segment of his scientific career was devoted to a study of the problems of pattern in the amphibian egg. He was especially interested in the distribution of pigment and yolk platelets in the egg, the relationship of the zygotic pattern to that of the future embryo and the nature and importance of the secondary investments of the egg—the chorion and the layers of jelly.

Dr. Monroe E. Deutsch, provost of the University of California and a close friend of Dr. Daniel's, recently stated that an epitome of Daniel as an administrator would be the one word—*just*. Dr.

Daniel's experience in university administration began long before he became head of the department of zoology. He rendered noteworthy service as chairman of some of the important faculty committees such as the committee on budget and inter-departmental relations and the library committee. In the opinion of the author, Dr. Daniel's most significant contribution as chairman of his department was his interest in and encouragement of young men and women of high scholarship. His graduate assistants were selected with exceeding care and their apprenticeship in teaching and development as scientists and scholars were carefully studied. To them he was personally devoted, far more, perhaps, than they will ever know. In his passing they have lost a friend and a counselor; he survives, however, a symbol and a creed.

RICHARD M. EAKIN
UNIVERSITY OF CALIFORNIA, BERKELEY

RECENT DEATHS

DR. FRANZ BOAS, professor emeritus of anthropology of Columbia University, died on December 21 at the age of eighty-three years.

DR. FRANK DAWSON ADAMS, Logan professor of geology at McGill University from 1894 to 1931 and emeritus vice-principal of the university, died on December 26 at the age of eighty-four years.

DR. JABEZ HENRY ELLIOTT, president of the American Association of the History of Medicine and professor of the history of medicine at the University of Toronto, died on December 18. He was sixty-nine years old.

DR. WILLIAM MARTIN BLANCHARD, professor of chemistry and dean emeritus of the DePauw University College of Liberal Arts, died on December 21. He was sixty-eight years old.

DR. HANS G. BEUTLER, research associate in physics at the University of Chicago, died on December 15 at the age of forty-six years. Dr. Beutler, who came to this country in 1936 from the Kaiser Wilhelm Institute for Physical Chemistry in Berlin, was a spectroscopist.

SCIENTIFIC EVENTS

TERCENTENARY OF THE BIRTH OF ISAAC NEWTON[1]

WHEN the tercentenary of the birth of Sir Isaac Newton was celebrated by Fellows of the Royal Society, in the Royal Institution, in December, Sir Henry Dale, president of the society, announced the successful conclusion of negotiations to acquire and preserve the birthplace "of the greatest of our men of science." The Pilgrim Trust, he said, will be responsible for the sum required for the purchase, which the Lord of the Manor of Woolsthorpe (Lincolnshire) has agreed to at a price substantially less than its value.

Sir Henry Dale described how

> in the hamlet of Woolsthorpe, near Colsterworth, on the Great North Road, some six miles south of Grantham, there is still a modest manor farmhouse, with a small orchard in front of it. Here the Newtons lived, simple yeoman farmers, and here, two months after his father had died, Isaac Newton was born, a puny, premature infant, on Christmas Day, 1642, 20 years before the Royal Society was incorporated by the grant of its first charter. The house stands but little altered since that day. The room in which Newton was born has a simple marble tablet on the wall, inscribed with Pope's well-known couplet.
>
> But this house had importance in Newton's later life and in his work, and not only as his birthplace. It was here that he returned from his schooling at Grantham, at the age of 16, to take charge of the farm for his mother; and here, to the incalculable gain of science and the world, he showed such incompetence as a farmer that he was sent back to school and thence to Cambridge. It was here, again, that he returned in the autumn of 1665, when the plague drove him from Cambridge; and here, during the following 18 months of quiet exile in the country, his early ripening genius grasped already the essential principles of his major theoretical discoveries. One can still see the upper chamber which he then used as a study; and in the little orchard there is an old, recumbent apple tree which, one will be told, is descended by direct grafting from that which Newton saw.

The land which Newton's family farmed was rapidly being laid waste by quarrying for iron-stone and soon there would have been little left unspoiled save the orchard and garden round the house. The Royal Society felt that something should be done to preserve for posterity a house and garden which carried such momentous memories, and which had meant so much for science. Accordingly a small committee was formed, in which Sir John Russell and Sir James Jeans joined with the officers of the society to negotiate with the lord of the manor, Major E. B. Turnor, of Ponton Hall, near Grantham, in order to put this tiny but historic property for as long as possible beyond the risk of damage or decay.

1 The *Times*, London.

ELECTION OF THE PRESIDENT AND OTHER OFFICERS OF THE AMERICAN CHEMICAL SOCIETY

DR. THOMAS MIDGLEY, JR., vice-president of the Ethyl Corporation, known for his discovery of tetraethyl lead which has made possible dramatic advances

in automotive and aircraft engines, has been elected president of the American Chemical Society for 1944.

Dr. Midgley will take office as president-elect on January 1, when Dr. Per K. Frolich, director of the Chemical Division, Esso Laboratories of the Standard Oil Development Company, Elizabeth, N. J., a leader in the development of synthetic rubber, becomes president, succeeding Dr. Harry N. Holmes, head of the department of chemistry at Oberlin College.

Dr. Midgley was chosen by the council from four nominees receiving the largest number of votes in a national mail ballot of approximately 32,000 members of the society. The council includes national officers, directors, editors of the publications, past presidents, the chairmen of eighteen professional divisions and councilors from a hundred local sections, and councilors-at-large.

Dr. Walter A. Schmidt, president of the Western Precipitation Company, Los Angeles, Calif., was elected a director-at-large to succeed Dr. Midgley. Dr. Leason H. Adams, of the Geophysical Laboratory of the Carnegie Institution of Washington, and Professor Robert E. Swain, of Stanford University, were reelected regional directors.

New councilors-at-large are: Dr. M. L. Crossley, director of research of the Calco Chemical Division, American Cyanamid Company, Bound Brook, N. J.; Professor Vincent du Vigneaud, head of the department of chemistry, Cornell University Medical College, New York; Dr. W. Albert Noyes, Jr., professor of physical chemistry in the University of Rochester, and Professor R. L. Shriner, chairman of the department of chemistry of Indiana University.

According to the official announcement of the society:

Dr. Midgley has won recognition for discoveries which are outstanding both from the standpoint of pioneering in new fields and from the standpoint of commercial importance. His discovery in 1922 of tetraethyl lead as an antiknock agent was made after he and his colleagues in the General Motors Research Laboratories had tried more than 33,000 different chemical compounds without success.

The performance of the modern military and transport plane, it is pointed out, is due in large part to the spectacular development of high-octane gasoline, a development in which tetraethyl lead, now a vital war material, has played an important role.

He has contributed largely to the knowledge of the chemistry of rubber and the methods of synthesizing rubber. With Dr. Albert L. Henne, of the Ohio State University, he developed the organic chlorofluorides which have become widely used as non-inflammable, non-toxic refrigerants. He was associated with the developments connected with the recovery of bromine from sea water.

Dr. Midgley, speaking on the occasion of the award to him of the Willard Gibbs Medal of the Chicago Section of the American Chemical Society on May 22 of this year, stated that "America's acute shortage of rubber must be laid to rubber technologists who have failed to develop practical methods of separating this vital material from plants growing plentifully in our own country."

Dr. Midgley has also been awarded the Priestley Medal of the American Chemical Society, the William H. Nichols Medal of the New York Section, the Perkin Medal of the Society of Chemical Industry and the Longstreth Medal of the Franklin Institute. Wooster College conferred the honorary degree of doctor of science upon him in 1933. He is a member of numerous scientific organizations.

Dr. Midgley was born on May 18, 1889, at Beaver Falls, Pa. His father, Thomas Midgley, an inventor and manufacturing executive, came to the United States from London, England, at the age of six. Dr. Midgley attended the public schools of Ohio and later Betts Academy at Stamford, Conn. He received the degree of mechanical engineer from Cornell University in 1911.

After his graduation he entered the employ of the National Cash Register Company, Dayton, Ohio. Later, with his father, he established the Midgley Tire and Rubber Company of Lancaster, Ohio. In 1916 he returned to Dayton and began work under Dr. Charles F. Kettering, with whom he has since been associated in various activities, including the organization of the General Motors Research Corporation. He is vice-president of Kinetic Chemicals, Inc., chairman of the Board of Directors of the American Chemical Society and vice-president of Ohio State University Research Foundation. He holds about one hundred patents.

AWARD OF THE EDISON MEDAL TO DR. ARMSTRONG

THE Edison Medal for 1942 has been awarded by the American Institute of Electrical Engineers to Dr. Edwin Howard Armstrong, professor of electrical engineering at Columbia University, "for distinguished contributions to the art of electric communication, notably the regenerative circuit, the superheterodyne, and frequency modulation." The medal will be presented to Dr. Armstrong an the evening of January 27, in the Engineering Auditorium, 33 West 39th Street, New York, N. Y., during the national technical meeting of the institute to be held in the Engineering Societies Building from January 25 to 29.

The Edison Medal was founded by associates and friends of Thomas A. Edison, and is awarded annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts" by a com-

mittee consisting of twenty-four members of the American Institute of Electrical Engineers. A statement issued by the institute reads:

Edwin Howard Armstrong was born in New York City on December 18, 1890. He began his engineering studies at Columbia University and became a protégé of Michael I. Pupin, Edison Medal recipient in 1920, with whom he worked closely on many important research undertakings.

While an undergraduate he became interested in the operating properties of the audion detector and set out to learn more of the principles of operation of thermionic tubes. The research that followed at his home in Yonkers, New York, resulted in his invention of the feedback or regenerative circuit which became the means not only of increasing the sensitivity of the audion as a detector of radio signals but also became the means of producing for the first time continuous high frequency oscillations by means of a thermionic tube. He filed applications on this invention in the latter part of 1913 and a patent was issued to him on October 6, 1914. In December, 1914, he published the first scientifically correct explanation of detection and amplification in the audion detector and in March, 1915, disclosed the regenerative and oscillating circuits.

This keystone of radio development was later to become involved in fourteen years of litigation and which in the end was decided by lay courts based on errors of fact and judgment which were contrary to the scientific facts.

He was graduated from Columbia University in 1913 with a degree of electrical engineer, and continued as an assistant in the department of electrical engineering. In 1915, he received the Trowbridge Fellowship from Columbia University.

In 1917, Armstrong entered the service of the United States Army as a Captain in the Signal Corps, and later was promoted to rank of Major. While serving in this capacity in France, he made his second invention which was destined to be another cornerstone in the development of the radio communication art. This was the superheterodyne receiving system.

This system of receiving far surpassed any development up to that time and it is still the type of circuit used to-day in practically all radio receivers.

The third outstanding invention was his development of the super-regenerative circuit which was disclosed to the art in 1922. This system of radio reception provides a means of increasing the sensitivity of a detector above that normally obtained by means of simple regeneration. This receiving circuit supplied the principal means of exploring and developing the ultra short wave channels.

The fourth outstanding invention of Major Armstrong was the development of wide band frequency modulation in 1933. This system is now recognized as the basis for an entirely new era in radio broadcasting and communication. All the broadcasting companies and many individual broadcasters have either applied to the Federal Communications Commission for licenses or have transmitters in operation using this system. There are 17 stations already on scheduled operation and it is conservatively estimated that 30 or more will be in service by the end of the year. The Federal Communications Commission has over 150 applications pending before it at this time.

This system of radio communication is radically different from the amplitude modulation system now in general use. It provides a means for producing static-free and noise-free signals with a fidelity and tonal range not previously obtained with the present broadcast facilities. In addition to eliminating much of the noise level from broadcast radio programs which are prevalent in urban areas the system provides means for transmitting on several separate channels over one carrier and in addition makes possible the use of the same carrier frequency by a number of stations separated by only a few hundred miles without causing mutual interference on that frequency.

Probably no one man has contributed as many fundamental radio inventions which so closely touch on our everyday life as Major Armstrong. The discovery of the regenerative circuit made possible long distance wireless communication and the building and operation of world-wide communication systems. Then, as broadcasting began to grow, the superheterodyne circuit became the greatest stimulant to the art bringing with it better reception and the attendant increase in enjoyment to millions of listeners. At the same time the manufacture of apparatus and the building and operation of stations brought work and prosperity to thousands. The super-regenerative circuit made practical the first 2-way police communication systems on the ultra short waves and has resulted in more rapid police action in safeguarding property and in the protection of life and limb. Now the frequency modulation system of communication is beginning to give the public a finer radio service and like Major Armstrong's other inventions is destined to add much to the nation's enjoyment and wealth.

Professor Armstrong has received many honors, including the degree of doctor of science from Columbia University in 1929, and from Muhlenberg College in 1941, the Medal of Honor of the Institute of Radio Engineers, 1917, the Egleston Medal of Columbia University, 1939, the Holley Medal of the American Society of Mechanical Engineers, 1940, the Franklin Medal of the Franklin Institute, 1941, and the John Scott Medal, awarded by the Board of Directors of City Trusts, City of Philadelphia, 1942. He was made a Chevalier de la Légion d'honneur by the French Government in 1919. He received one of the nineteen national awards of "Modern Pioneer" by the National Association of Manufacturers in 1940.

SCIENTIFIC NOTES AND NEWS

SIR HENRY DALE was reelected president of the Royal Society at the two hundred and eightieth anniversary meeting which preceded the celebrations of the tercentenary of the birth of Isaac Newton.

DR. EVARTS A. GRAHAM, Bixby professor of surgery, Washington University School of Medicine, St. Louis, was presented with the St. Louis Award during special ceremonies in the mayor's office on November 5. The award is given annually by an anonymous donor to the citizen of St. Louis who has made "the most outstanding contribution to the community during the year." It includes a check for $1,000 and a certificate. The award was made in recognition of Dr. Graham's development of pulmonary and hepatic surgery, his productive leadership as a teacher of students and practitioners and for his influence on surgical theory and practice, and in particular for his "comprehensive focusing of present knowledge on the treatment of war injuries, thereby making this information easily available to all surgeons for the conservation and rehabilitation of the victims of the carnage of war."

EDWIN C. WELLS, principal contributor to the design and engineering work on the flying fortresses manufactured by the Boeing Aircraft Company of Seattle, will receive the Lawrence Sperry Award of the Institute of the Aeronautical Sciences. The citation reads: "For outstanding contributions to the art of airplane design with special reference to four-engined aircraft."

E. MEAD JOHNSON AWARDS for research in pediatrics for 1941 were presented through the American Academy of Pediatrics at its annual meeting in Chicago in November. The prize of $500 was presented to Drs. Howard A. Howe and David Bodian for their work in poliomyelitis, and the prize of $300 went to Drs. Harold E. and Helen C. Harrison for their "painstaking work on the excretion and absorption of phosphate by the kidneys."

FREDERICK S. BACON, director of a laboratory for chemical research and consultation in Watertown, Mass., has been elected chairman of the Northeastern Section of the American Chemical Society.

THE following officers were elected at the annual general meeting of the British Rheologists' Club, held on November 6: *President,* Dr. C. F. Goodeve; *Honorary Secretary,* Dr. G. W. Scott Blair; *Honorary Treasurer,* Dr. V. G. W. Harrison. After the transaction of formal business, Professor E. H. Rideal gave an informal address on "Solutions of Macromolecules."

DR. CYRIL BANKS, of Nottingham, has been installed as president of the British Society of Medical Officers of Health.

PROFESSOR EDWARD M. LEHNERTS, chairman of the department of geology and geography of Hunter College, New York City, has retired. He was appointed associate professor in the department of natural sciences in 1920, and became head of the department of geology when it was established in 1921. In 1929, he was promoted to a full professorship and in 1938 became chairman of the department of geology. Professor Henry D. Thompson has been elected to finish the unexpired term of Professor Lehnerts.

THE *Journal* of the American Medical Association states that Dr. Joseph S. Lichty, Shaker Heights, Ohio, of the Cleveland Trust Company, has been appointed assistant dean of the faculty of medicine at Harvard University and assistant professor of medical administration. Dr. Franklin F. Snyder, Chicago, has been appointed associate professor of anatomy and obstetrics at the Medical School. Dr. Frederick J. Stare, of the University of Wisconsin, has been appointed assistant professor of nutrition, which is reported to be a new title connecting the clinical and laboratory branches of nutritional science. Dr. Stare will work both in the laboratory and in the field in connection with the Medical School and the School of Public Health. Dr. Henry P. Treffers, an immunochemist, has been named to the newly established position of assistant professor of comparative pathology and biologic chemistry. A new office, known as "Medical School Research Laboratories," has been organized under U. Haskell Crocker. The object is to coordinate and centralize the business details of the various research projects in progress, operating under contract with the Office of Scientific Research and Development.

DR. WALTER B. CARVER, professor of mathematics at Cornell University, takes office on January 1 as secretary-treasurer of the Mathematical Association of America. The national headquarters of the association will be moved to Cornell University from Oberlin College. Professor Carver succeeds Professor W. D. Cairns, of Oberlin, who retires from the position he has held since the association was founded in 1915.

DR. SIDNEY J. FRENCH, professor of chemistry at Colgate University, has been appointed to serve as coordinator of the Naval Flight Preparatory School which will open on January 7. He will organize and direct the new faculty, which will include about fifty teachers. An attendance of six hundred aviation cadets is expected.

DR. CHESTER NORTH FRAZIER has been made professor of dermatology and syphilology at the Medical School of the University of Texas at Galveston. He was formerly professor of dermatology and syphilology at Peiping Union Medical College, China, where he had served for some twenty years. While at Peiping he was instrumental in helping to develop the medical library of the college.

DR. M. DEMEREC, who has been serving as acting

director of the Department of Genetics of the Carnegie Institution of Washington at Cold Spring Harbor, L. I., N. Y., becomes director on January 1, and Dr. Thorne M. Carpenter, acting director, has been made director of the Nutrition Laboratory of the institution in Boston. Dr. Demerec has been associated with the Department of Genetics since 1923, and Dr. Carpenter with the Nutrition Laboratory since 1907.

DR. JOHN W. HEUBERGER, plant pathologist at the Connecticut Agricultural Experiment Station, New Haven, left at the end of November to join the research staff of the Rohm and Haas Company of Philadelphia. Working under the Crop Protection Institute at the New Haven Station, Dr. Heuberger carried on research in organic fungicides. He will continue this work at the Subtropical Experiment Station, Homestead, Fla.

DR. ROBERT L. PENDLETON has been appointed principal soil technologist at the Office of Foreign Agricultural Relations of the U. S. Department of Agriculture. He has been detailed to proceed to Nicaragua and other countries in tropical Latin America in connection with the establishment of the joint agricultural experiment stations. Until Thailand declared war on the United States, he was agricultural adviser and soil scientist to the government there. He was thereafter interned and repatriated on the *Gripsholm*.

PROFESSOR EDWARD KASNER, of Columbia University, recently opened a series of lectures at St. John's College, Annapolis, on the relations of mathematics to the sciences.

ACCORDING to an Associated Press dispatch, Dr. Theodore Dykstra, of the Bureau of Plant Breeding of the U. S. Department of Agriculture, and Dr. Walter C. Lowdermilk, chief of the Division of Research in Soil Conservation, arrived in Chungking on December 10. They left the United States on September 15. They will be joined by a corps of approximately thirty American specialists who will assist in the modernization of the agricultural methods of China.

DR. DAVID RANDALL PYE, formerly fellow of Trinity College, Cambridge, and of New College, Oxford, who has been for many years connected with the scientific side of aeronautics and who succeeded H. E. Wimperis as director of scientific research to the British Air Ministry, has been appointed to succeed Sir Allen Mawer as provost of University College, London.

WILLIAM B. WIEGAND, of the Columbian Carbon Company of New York, has been appointed a member of the Synthetic Rubber Advisory Committee of the Department of Munitions, Ottawa, Canada. Dr. R. V. Yohe, of Akron, Ohio, has retired from the committee.

DR. HENRY B. BIGELOW, professor of zoology and curator of oceanography at Harvard University, has been appointed special representative in charge of Navy V-1 and V-7 enlistments at the university.

GEORGE A. HARDER, publicity director of the Westinghouse Radio Stations, Inc., has reported for active service as a captain in the chemical warfare branch of the Army.

SCIENCE has received the following correction from the Materiel Center of the Army Air Forces: "Attention is directed to the first paragraph of the article 'Oxygen Masks for the A.A.F.' on page 531, of the December 11, 1942, issue of SCIENCE, where a misstatement of fact has been made. The Field Museum of Chicago, Illinois, has not been invited to supervise the production of oxygen masks for the Army Air Forces nor have they been consulted at any time by the Materiel Center in the design of these masks."

THE American Mathematical Society met at the University of Notre Dame on November 27 and 28, with an attendance of seventy mathematicians, eight states being represented. Twelve research papers were presented and discussed and eight additional papers were read by title. As a part of the meeting, the University of Notre Dame held its annual Mathematical Symposium, the subject being "Modern Statistics." In this symposium Professors Jerzy Neyman, of the University of California, and Abraham Wald, of Columbia University, gave two lectures each covering their recent work on the statistical theory.

THE History of Science Society announces the cancellation of its December meeting. The annual business meeting of the society will be held on Thursday, January 7, at 3 P.M., at the Hotel Pennsylvania, New York City.

PRESIDENT ROOSEVELT has signed a bill authorizing the rank of rear admiral in the Dental Corps of the Navy. Previously the highest rank in that corps was captain. It is explained that the Dental Corps is expanding rapidly and that the senior position there now should receive a rank comparable to that of a chief Navy physician, which is rear admiral.

FOR accomplishing "more than seemed reasonable or possible" in the production of chemicals and metals for war, the Dow Chemical Company was presented, on December 29, with two Army-Navy "E" pennants. The Dow Chemical Company is one of the largest producers of industrial chemicals and pioneered in the production of magnesium metal. The chief speaker at the presentation was Major General William N. Porter, chief of the Chemical Warfare Service.

AT a recent general meeting of the Zoological So-

ciety of London, the council, according to the *Times*, London, reported that the number of visitors to the Gardens during the past three months was 629,227 and receipts for admission amounted to £30,091. The total number of visitors during the year up to the end of October was 1,313,821 and the receipts amounted to £56,030, showing an increase of £39,504 compared with the corresponding period of the previous year and of £14,203 compared with the average for the previous five years. The number of visitors to Whipsnade Park during the year up to the end of October was 99,510 and receipts amounted to £4,581, showing a decrease of £5,322 compared with the corresponding period of the previous year.

DISCUSSION

SEVERITY OF NARCISSUS BASAL ROT INCREASED BY THE USE OF SYNTHETIC HORMONES AND NITROGEN BASES

COMMERCIAL bulb growers have recently become interested in the possibility of using growth-regulating substances to obtain increased flower and bulb production as well as disease control. Several materials purporting to accomplish these objectives are now on the market. The effect of a number of such compounds on narcissus bulbs, variety King Alfred, has been studied at the Bureau of Plant Industry Station, Beltsville, Maryland, during the past two years. Included in these studies have been naphthalene acetamide, indolebutyric acid, indoleacetic acid, naphthaleneacetic acid, uric acid, guanidine and allantoin. Before planting in the fall some bulbs were dipped in solutions containing 10 to 100 p.p.m. of these compounds, others in talcum powder containing 1 to 10 parts of these compounds in 5,000 parts of talcum. Several thousand bulbs were planted in suitably replicated plots. In every trial the application of the hormones or nitrogen bases increased the amount of basal rot over that in comparable untreated bulbs. Bulbs apparently healthy were treated after harvest with several of the above-named compounds and developed a significant increase in the amount of basal rot during storage.

In laboratory studies the addition of naphthalene acetamide, indolebutyric acid, allantoin, uric acid and adenine sulfate stimulated the growth of *Fusarium oxysporum* f. *narcissi* (Cke. et Mass.) Sny. and Han., the causal organism of basal rot. This is believed to be the first report of stimulation of a plant pathogen by a synthetic growth-regulating substance of the hormone type or by a nitrogen base. Data presented in a paper by Greathouse and Rigler[1] seem to indicate that increased growth of *Phymatotrichum omnivorum* (Shear) Duggar occurred when xanthine and adrenaline were added to the nutrient solution. At the Buffalo, New York, meeting of the American Chemical Society in 1942 Martin and Fisher reported that adenine increased the virulence of *Escherichia coli*.[2]

[1] Glenn A. Greathouse and Neil E. Rigler, *Phytopath.*, 30: 475–485. 1940.

[2] Gustav J. Martin and C. Virginia Fisher, *Abstracts*, American Chemical Society meetings, 28B, 1942.

Further studies on the effect of synthetic hormones and nitrogen bases on growth and pathogenicity of the basal-rot pathogen and other organisms are in progress and a more extensive report will be presented elsewhere.

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WHAT IS A GENERIC NAME?

RECENT discussion in this journal on the use of generic names has surprised and puzzled some of my colleagues and me. Certain scientists appear to be exercising a remarkable ingenuity in extricating themselves from a difficulty which does not exist. To these persons it seems to violate some sacred canon to add a plural (or other) termination to the Latin name of a genus. *Paramecium* is correct, but I may not write *Paramecia;* instead I must struggle with such unwieldy phrases as "specimens of *Paramecium*." Or, to adopt the proposed solution of the "difficulty," I may transform the name into a "common noun" and write "paramecia."

According to S. O. Mast,[1] "a generic name is always a collective noun" and "refers to all the individuals which are similar to the type specimens of the genus." By grammatical definition, therefore, it is not a proper noun, which is the name of a single individual. But the same writer further implies that it is not a common noun, since he says he has "obviated this [the difficulty above mentioned] by using the generic name as a common noun." If a name is neither a common noun nor a proper noun, would it be improper to refer to it as an uncommon noun? C. D. Beers,[2] however, gives us the clue to this confusion when he remarks: "The following are some common animal names (hence common nouns). . . ." By "common nouns" in this discussion we are evidently to understand words in everyday use, and nothing grammatical.

The trouble is deeper than grammar—and more important. "A generic name . . . is always in the

[1] SCIENCE, 96, 252, 1942.

[2] SCIENCE, 96, 403, 404, 1942.

nominative case and it is always singular in number." I believe that Mast is here quoting or at least paraphrasing the rules of zoological nomenclature. The corresponding botanical code says that "Names of genera are substantives . . . in the singular number . . ." without allusion to their case. The difficulties adumbrated by the authors cited originate in a too servile adherence to these carelessly worded dicta. The botanical version has one solecism fewer than the zoological, but it is inconceivable that either represents the real thought of the framers of the codes. Obviously, the name of a genus is a nominative singular when taken by itself, or for entry in a catalogue or index; likewise the name of a family is a nominative plural. It can scarcely be the sense of any self-respecting code of nomenclature that such a name can not be treated as other names are treated when it is introduced into discourse. When a generic name is the object of a verb, it is no longer "in the nominative case"—rules or no rules.

Linnaeus wrote: "Cerealia sunt semina majora graminum . . .: *Oryza, Triticum, . . . Mays,* excepto forte solo *Lolio,* nisi arte praeparato." And again: "Semina minora *Phalaridis, Panici, Milii, . . .*" More than a hundred years later Bentham and Hooker wrote: "Genus potius *Sisyrinchio* quam *Solenomali* affine videtur." A modern writer, describing a new genus of algae, characterizes its thallus as "erectus ex fundamento radicato in cryptostomatibus *Cystoseirae* immerso." How else could you say these things? To say that a word is "always in the nominative singular" is tantamount to saying that it can not be used in a sentence except as the subject of the verb. Are we to pretend that the italicized words in these quotations are not names of genera but "common nouns"? In English we have no endings for genitives and ablatives; so we say "seeds of *Panicum*" and the like. But we do have plural forms, and we need not hesitate to use in an English sentence the plurals of Latin words, as we do those of *nucleus* and *alumnus*. *Crataegi* means members of the genus *Crataegus,* as "the Smiths" means members of the Smith family. If English had case-inflections, we should undoubtedly enjoy dative, ablative, locative and genitive Smiths, to say nothing of vocative Smiths ("O Smittee . . .").

Obviously, there is need here for clarification of the rules of nomenclature. To say that names can not be declined is not only without precedent in grammar or in science—it is without use. If our steed is to carry us surely and swiftly, it is inadvisable to hamstring him. What mirth would be provoked among the "fathers" of our science if they could see their successors laboring to render impotent the technical language which they devised!

H. W. RICKETT

THE NEW YORK BOTANICAL GARDEN

A NEW GENERAL TERM FOR MINERAL INDUSTRIES STUDIES

DURING the recent summer the undersigned received from Dean Edward Steidle, of The Pennsylvania State College School of Mineral Industries, a letter part of which follows:

> I am trying to find a word that will be all-embracive for earth sciences, mineral economics, mineral engineering and mineral technology, i.e. mineral service, mineral work or mineral utilization. If there is no word, I have in mind that a new word might be coined. . . .

The purpose of the present communication is to bring before earth scientists the term that the undersigned has suggested. It appears to embrace the techniques and studies involved, to be readily pronounced, to be easily recognized and understood, and to the writer, a Hellenist, to have the virtue of sound etymological formation. The new word is "geotechnology."

It is the considered opinion of the writer and of Dean Steidle that this is a new term, and we thus record it. Specific reference to contrary evidence will be greatly appreciated.

ROBERT E. DENGLER

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SPECIAL CORRESPONDENCE

SUGGESTIONS FROM THE OFFICE OF SCIENTIFIC PERSONNEL OF THE NATIONAL RESEARCH COUNCIL

As soon as the Army and Navy training programs are in full operation there will be an unprecedented demand for teachers of physics and mathematics. The situation will be particularly critical in the field of physics where the teaching ranks of colleges and universities have already been seriously depleted.

It is the business of the Office of Scientific Personnel to assist in the placing of the scientific specialist where he can best serve the war effort. Because the present supply of physicists approximates zero and the supply of mathematicians is running low, perhaps this office can assist best by suggesting two sources of supply close at hand to the institutions which are so fortunate as to secure Army and Navy contracts.

The first source of supply is the near-by institutions which will not have Army or Navy training programs. Although these institutions should con-

tinue to teach physics to as many students as possible, some departments of physics will find it impossible to continue in operation and their staff members should be added to departments in need of their services.

The reason why all departments of physics which can possibly do so should continue in operation is that it is probable that the needs of the Army and the Navy will be barely satisfied through the training programs. The needs of war research, war industry and teaching must be satisfied, for the most part, by women and the physically unfit. In this connection it should be mentioned that there seems to be no possibility of meeting the need for competent teachers of physics in the secondary schools.

Accordingly, it is important that colleges which are not fortunate enough to secure training contracts should continue to teach physics to even larger numbers than before. So great is the need for men and women trained in physics that every effort should be made to recruit into departments of physics all students with the necessary aptitude.

These considerations make it clear that the more favored departments should not take men from other institutions unless it is necessary for these men to find employment elsewhere. The other source of supply, and the one that should be utilized wherever possible, is within the institution itself.

In any college or university there are teachers in other fields, including botany, geology, physiology, psychology and zoology, who have sufficient knowledge of physics so that, with a little brushing up and some observation of good physics teachers at work, they should become proficient teachers of beginning physics. These men and women should be found at once and encouraged to prepare themselves for the teaching service which they will almost certainly be called upon to perform either at their own institutions or elsewhere.

Similar adjustments, although on a smaller scale, will be necessary in the field of mathematics.

It is the hope of this office that most of the required readjustments in the staffs of physics and mathematics departments may be worked out by drawing in new staff members from near-by institutions or by adjustments within the institutions themselves. This office will facilitate such adjustments in every way possible if they can not be worked out locally and will be glad to receive information regarding institutional needs and available personnel but only with the understanding that we will attempt to prevent bidding of institution against institution in mad competition for personnel. It is to the interest of all concerned that a sufficient supply of teachers of physics and mathematics should be developed so that the necessary readjustments may be made easily and efficiently.

HOMER L. DODGE

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SCIENTIFIC BOOKS

ADVANCES IN ENZYMOLOGY

Advances in Enzymology. Volume II. Edited by F. F. NORD and C. H. WERKMAN. 374 pp. Interscience Publishers Inc., New York. 1942.

THE second volume of "Advances in Enzymology," this excellent successor to "Ergebnisse für Enzymforschung," edited by Nord and Werkman, has fulfilled the expectations of those who read the first volume, although there are some articles which have departed somewhat from the field a book of this kind is expected to cover.

The first article in particular, "Bacterial Viruses (Bacteriophages)" by M. Delbrück, seems to be outside the scope of enzymology. After calling bacteriophage a virus ("what's in a name?") Delbrück tells his readers that there are at present two aspects of the phage problem of particular interest: "the biochemical basis of the specific relation of the phage to its host" and "the problem of phage growth." Then he proceeds with remarks about "distribution in nature," "methods of assay," "the 'Life Cycle' of virus in sensitive hosts," etc., and leaves the reader with the same curiosity as when he started regarding the two aspects of particular interest. Neither of the two aspects is discussed in a manner to satisfy or clarify the mind of the student of enzymes.

The kinetics of hydrolytic enzymes has been presented by D. D. Van Slyke in the second article with his usual clarity. The assumption of substrate-enzyme complex formation first formulated by Michaelis and now generally accepted has been treated by Van Slyke with such unusual success that a study of this paper is recommended to any one interested in the kinetics of enzyme systems in general. The "Classification of Proteolytic Enzymes" by M. Bergman fills a need long felt. Professor Bergman must be congratulated for having resolutely discarded the outmoded but tenaciously retained classification of proteolytic enzymes in peptidases and proteinases. His tentative classification, based on two characteristics of proteolytic specificity, namely, that each proteolytic enzyme

requires the presence of certain atomic groupings within the main body and within the side chain of the reacting molecule, is a step forward toward a rational nomenclature. Bergman's discussion of the nature of proteolytic enzymes is evidence that the rapid progress made in the field of oxidation enzymes has also aided in the better understanding of the nature of other enzymes. Proteolytic enzymes are far simpler than oxidation enzymes as they resemble in their chemical constitution the first type of oxidation enzymes, the metalloproteins; the fact that certain metals act as "activators" does not mean, as Bergman correctly points out, that "the active enzyme is composed of an inactive apoenzyme and an activator" but that the particular enzyme is made up of a protein combined to a metal both being equally essential for enzyme action in the same manner as polyphenol oxidase is a Cu-protein. The example of coupled reaction given by Bergman—the hydrolysis of glycyl-l-leucine by papain on addition of acetylphenylalanylglycine—is so clearly presented that the reader can immediately understand the observations and conclusions of Schoenheimer on the continuous splitting and synthesis of the protein molecule wherever those enzymes are present. Johnson and Berger provide, in their article on the enzymatic properties of peptidases, more examples of proteolytic enzymes made up of metalloproteins (Zn, Mn, Mg-proteins).

Zeller's article on diamine oxidase shows how difficult it is to discard old, misleading terminologies (aerodehydrases, oxydehydrases). In spite of the considerable work done by Zeller and his coworkers, in spite of the solubility of the enzyme, it has not yet been prepared in reasonably purified condition; furthermore, the enzyme preparation of Zeller, the properties of which are discussed in this paper, is rather inactive compared with that of Laskowski (personal communication). The problem of specificity, of the components of the enzyme system, will not be elucidated until a better preparation of diamineoxidase than that of Zeller is obtained. His excellent contributions will be always helpful. Roberts, who for years has studied the chemical processes during the manufacture of black tea, discusses the chemistry of tea-fermentation (oxidation of the leaf-tannins). The author's hypothesis that tea-tannins are oxidized by cytochrome oxidase has no valid support. Although we are in thorough agreement with Roberts in his insistence that cytochrome oxidase might be different in different cells, and would readily grant that cytochrome oxidase exists in tea-leaf, we must conclude that he offers no evidence for his opinion. No argument is given against the simpler assumption that the enzyme is a Cu-protein similar to polyphenol oxidase. Tea tannins consist mainly of the simpler condensation products of epi-catechin and gallo-catechin, o-quinones being the first product of oxidation; these, according to Roberts, condense afterwards. The kinetics of these condensation reactions are briefly discussed. Roberts's discussion of the mechanism of tea-fermentation must be read with attention by all students of oxidation-reduction processes. Although his conclusions and his hypotheses have no factual foundation and even run counter to established concepts, the presentation of the problem opens a field full of questions to be answered.

To discuss the problem of heterotrophic assimilation of carbon dioxide no more appropriate selection could have been made than that of Werkman and Wood, the undisputed pioneers and leaders in this field, the investigators who for the last seven years have been courageously trying to convince biologists that living cells could assimilate CO_2 by other processes than photosynthesis. This chapter is so well presented that the reviewer can only recommend its thorough study to all biologists interested in the physico-chemical processes of life.

H. Tamiya, who with his coworkers has contributed greatly to our knowledge of mould metabolism, has written the chapter on "Respiration, Fermentation and Enzyme Systems of Aspergillus." The exhaustive and careful study of the total metabolic balance of this mould, so useful to Japan, unfortunately has not been followed by a study of the mechanisms of oxidation-reduction. The pathways of carbohydrate fermentation and oxidation, for example, remain still a subject for study. It is especially unfortunate because *Aspergillus* seems to be one of those moulds where non-phosphorylating glycolysis exists, where the Szent-Györgyi cycle of accessory oxidation catalysts does not operate.

In their article on cellulose decomposition by microorganisms, Norman and Fuller give, after a brief presentation of the chemical structure and properties of cellulose, a good presentation of the probable mechanism of cellulose decomposition by bacteria and fungi. The extreme abundance of cellulose makes a careful study of these probable mechanisms necessary, because the controlled hydrolysis of cellulose or the controlled oxidation of its hydrolytic products might be used for the production on a large scale of the products of hydrolysis or oxidation.

"A Unified Hypothesis of the Reciprocal Integration of Carbohydrate and Fat Catabolism" is the title of an essay by E. J. Witzemann. The twenty "fundamental facts relating to fat and carbohydrate catabolism" do not help the reader in understanding the "unified hypothesis." Moreover, the first three of these fundamental facts are so naïve that the reader is left with no desire to go on with the remaining seventeen. The role assigned to choline in fat metabo-

lism is not in agreement with McHenry's conception of the function of choline, nor has it factual support. Biologists now go farther than Witzemann; they are aware of the interrelation not only of fat and carbohydrate metabolism but of all foodstuffs. They have been speaking for some time of pyruvic acid as the hub towards which the breakdown of foodstuff (carbohydrate, fat, protein) converges, from which synthesis starts.

H. Dam, the discoverer of vitamin K, has given us an excellent review of the chemical and physiological properties of this vitamin, and has shown that there still remain many obscure problems, such as the nature of the action of vitamin K on prothrombin formation.

Pfiffner's article on the "Adrenal Cortical Hormones" concludes the book. After reviewing the chemical properties of the different steroids extracted from the adrenals, the methods of assay, Pfiffner devotes one page (out of 27) to the effect of corticosterones on carbohydrate metabolism, unfortunate neglect when the article is written for "Advances in Enzymology."

The publishers are to be congratulated for the excellent care with which the book has been presented. The errors found in Van Slyke's article (pp. 34 and 39) were promptly corrected. It is unnecessary to say that this series must be in the library of every laboratory where there is interest in the mechanism of biochemical activities.

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BIOLOGICAL SYMPOSIA

Comparative Biochemistry, Intermediate Metabolism of Fats, Carbohydrate Metabolism and the Biochemistry of Choline. Edited by HOWARD B. LEWIS. ix + 247 pp. Illustrated. Jaques Cattell Press. 1942.

THE fifth volume of "Biological Symposia" deals with comparative biochemistry, intermediate metabolism of fats, carbohydrate metabolism and the biochemistry of choline. This volume is edited by Professor Howard B. Lewis, who provides a short introduction for it.

It may be stated immediately that there is a wealth of information in this collection of scientific articles. Those in which comparative biochemistry is discussed will be found of great value, not only to students who are interested in this subject specifically, but to workers in all branches of the biological sciences. The article on the end products of nitrogen metabolism in plants will be stimulating to those who are interested in nitrogen metabolism of animals. This latter subject is also discussed and it may in turn suggest new approaches to the problems of the plant biochemists and physiologists.

The article on the merging of growth factors and vitamins proves again the point that investigators of bacterial metabolism must keep pace with the rapid growth of our knowledge of the vitamins, while the vitamin experts will profit greatly by studying the results of investigations of the metabolism of bacteria.

Four articles on the intermediate metabolism of fat help us to keep abreast of this rapidly growing field and the changing views which must be adopted in light of the accumulating evidence. The symposium on carbohydrate metabolism deals primarily with the more purely biochemical aspects of the study and consists of four stimulating articles on "Oxidation Catalysts," "Phosphorylation of Glycogen and Glucose," "Oxidoreduction in Carbohydrate Breakdown" and "Pyruvate Oxidation and the Citric Acid Cycle." There is little doubt that many of the fundamental changes in sugars within the body are now being revealed. These short reviews should help materially to bring the subject up to date. Here again the interrelationship of the various fields discussed in this volume is obvious. The accessory food factors are assuming an ever-increasing role in all considerations of protein, fat and carbohydrate metabolism.

The four articles on choline provide a most useful picture of this relatively new but rapidly extending field. Choline, as a dietary factor, is now known to be intimately related to fat, protein, and more indirectly to carbohydrate metabolism as well as to many of the components of the vitamin B complex.

In this review it will be impossible, of course, to make any detailed summary of the information found in any of the four divisions into which the symposia fall. The general impression given by the whole volume is that a great deal of essential information has been gathered together and presented in a most pleasing and stimulating way. One is left with the feeling that a much more extended review of each of the fields would be most acceptable. This, however, would not be possible under the conditions of presentation of these symposia. It is to be hoped that editors will be found and the necessary arrangements made for the publication of the symposia which have more recently been presented before the Federation of American Societies for Experimental Biology.

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HURRICANES

Hurricanes. By I. R. TANNEHILL. x + 256 pages. 119 figures.]
Press. 1942.

THIS is one of the few meteorological "must" books. Teachers, at least, of meteorology and climatology must keep it close by for reliable reference. Mr. Tannehill, as chief of the Marine Division of the U. S. Weather Bureau, needed to have as full information as practicable of tropical storms in general and of the West Indies hurricane in particular, a need which his official position and the facilities of the Bureau's extensive library enabled him to meet. This information he neither lazily nor selfishly put aside for his private use, but industriously got together for the convenience of the hundreds of others who might want it.

It is a readable book, full of facts, historical and otherwise; and free from tedious theoretical discussions that would have had to be based at best on doubtful assumptions. Logically it begins with a clear description of a tropical cyclone or hurricane as one in the general region of the West Indies is called; of how reports of such a storm are obtained, and how warnings of its approach are issued.

This general discussion is followed by a number of chapters that consider in detail the winds, the barometric pressure, the torrential rains, tidal waves and other phenomena that accompany or are parts and parcels of a typical hurricane. The tracks of many of these storms are given, and their frequency, both annual and monthly, noted.

The last four chapters give the history of all West Indian hurricanes of record, extending from 1493 to 1941. One of these storms wrecked, as history tells us, certain vessels on their way, in 1609, to Jamestown, and inspired Shakespeare to write "The Tempest."

The book contains also a very full and, for students of the subject, an invaluable bibliography of hurricane literature and a good index.

W. J. HUMPHREYS

SPECIAL ARTICLES

COMPLEMENT FIXATION IN RICKETTSIAL DISEASES

THE complement fixation technique has proved adequate for serological separation of the rickettsial agents of endemic typhus,[1, 2] "Q" fever[3] and Rocky Mountain spotted fever.[4] The agents of epidemic and endemic typhus previously have not been distinguishable by this method, since cross reactions were obtained with materials from the two closely related diseases.[2, 5] It is now possible to prepare rickettsial antigens with which we can differentiate epidemic and endemic typhus antisera. Certain of the results obtained with these new antigens are of sufficient clinical and epidemiological interest to record at this time; the details of the method of preparation of the antigens will be given at a future date.

The method employed in performing the complement fixation test has been described.[4] The epidemic and endemic rickettsial antigens (Breinl and Wilmington strains) are prepared from infected yolk sacs of developing chick eggs and purified so that the diluted antigens contained 0.02 mg N per cc. The epidemic and endemic rickettsial antigens are standardized against convalescent sera of known titre obtained from human beings and guinea pigs recovered from epidemic and endemic typhus. Some cross fixation occasionally occurs, but when it does, the specific antigen always reacted with the homologous serum in a higher titre than with the heterologous serum.

Table I indicates the results obtained on specimens of serum obtained during convalescence in epidemic and endemic typhus and in Brill's disease.

In 43 cases of endemic typhus fever examined 36 gave a positive complement fixation with an endemic rickettsial antigen and a negative fixation with an epidemic rickettsial antigen. In six cases there was some cross fixation, but in every case where this occurred, the titre obtained with the endemic antigen exceeded that obtained with an epidemic antigen.

In 29 cases of epidemic typhus fever 26 gave a positive fixation with an epidemic rickettsial antigen and a negative test with an endemic antigen. In three cases there was some cross fixation, but in all instances where this occurred the titre obtained with the epidemic antigen exceeded that obtained with an endemic antigen.

All the patients included in the group of endemic typhus come from one of two areas in which this type of infection is known to occur, but in which epidemic typhus has not been found. The patients comprising the group of epidemic typhus come, in part, from an area where louse-borne typhus exists and, in addition, individuals are included who had laboratory infections and from whom epidemic strains have been isolated.

It has been observed that the immigrants who contract Brill's disease usually give a history of having had typhus while in Poland or Russia. Only one case

1 M. R. Castaneda, *Jour. Immunology*, 31: 285–291,

Bengtson, *Pub. Health Rep.*, 56: 649–653, 1941.
gtson, *Proc. Soc. Exp. Biol. and Med.*, 46:

Wertman, SCIENCE, 93: 441–442, 1942.

TABLE 1

	No. of cases	Epidemic Rickettsial Antigen	Dil. of serum	Endemic Rickettsial Antigen	Dil. of serum
Endemic Typhus					
43 cases	5	negative		4 plus	1 : 12
	12	negative		4 plus	1 : 24
	6	negative		4 plus	1 : 48
	9	negative		4 plus	1 : 96
	2	negative		4 plus	1 : 192
	1	4 plus	1 : 6	4 plus	1 : 96
	1	4 plus	1 : 6	4 plus	1 : 192
	4	4 plus	1 : 12	4 plus	1 : 48
	2	4 plus	1 : 12	4 plus	1 : 96
	1	4 plus	1 : 24	4 plus	1 : 384
Epidemic Typhus					
29 cases	2	4 plus	1 : 12	negative	
	1	4 plus	1 : 24	negative	
	1	4 plus	1 : 48	negative	
	2	4 plus	1 : 96	negative	
	13	4 plus	1 : 192	negative	
	6	4 plus	1 : 384	negative	
	1	4 plus	1 : 768	negative	
	1	4 plus	1 : 96	4 plus	1 : 24
	1	4 plus	1 : 192	4 plus	1 : 48
	1	4 plus	1 : 192	4 plus	1 : 96
Brill's disease					
23 cases	4	4 plus	1 : 12	negative	
	2	4 plus	1 : 24	negative	
	4	4 plus	1 : 48	negative	
	2	4 plus	1 : 48	4 plus	1 : 6
	1	4 plus	1 : 48	4 plus	1 : 12
	1	4 plus	1 : 96	4 plus	1 : 48
	1	4 plus	1 : 96	4 plus	1 : 12
	2	4 plus	1 : 384	4 plus	1 : 48
	3	4 plus	1 : 768	4 plus	1 : 192
	1	4 plus	1 : 960	4 plus	1 : 96
	1	4 plus	1 : 960	4 plus	1 : 384
	1	4 plus	1 : 1436	4 plus	1 : 192

usually occurs in a family, no vector or reservoir of the virus has been found, and the virus isolated from the blood of the patient has the characteristics observed for the epidemic strain. On the basis of these observations Zinsser[6] advanced the theory that Brill's disease represented a recrudescence of an old attack of typhus fever. Our observations bring serological evidence to substantiate this point of view.

In 23 cases of Brill's disease examined all showed a positive complement fixation with an epidemic rickettsial antigen. In 10 cases there was fixation with an epidemic rickettsial antigen and no fixation with an endemic rickettsial antigen. In 13 cases there was some cross fixation but in all instances where this occurred the titre obtained was higher with an epidemic antigen. The pattern of fixation in this disease resembles that obtained in epidemic typhus fever.

Absorption tests were performed on specimens of serum from Brill's disease where cross fixation had occurred. An endemic rickettsial antigen removed all the endemic antibody with slight effect upon the titre of epidemic antibody. On the other hand, a similar treatment of the serum with an epidemic rickettsial antigen resulted in the removal of both the epidemic and endemic antibody; no selectivity of absorption was observed. These results would indicate that the endemic rickettsial antigen pattern was different from that of the antigenic pattern of the epidemic strain. The removal unselectively of both endemic and epidemic antibodies by the epidemic antigen suggests that the epidemic antigen may be a more complete or complex antigen than the endemic antigen.

The implication of the results obtained in Brill's disease on the epidemiology of typhus fever is great. They would indicate that mild cases of epidemic typhus actually exist in the United States. The disease is not transmitted from person to person in this country simply because the louse vector is not present. Furthermore, these results indicate that one attack of typhus does not confer a lifelong immunity as is generally believed. The virus is probably harbored in the body and when the resistance is lowered the virus multiplies and induces a mild attack of the disease. If these cases should occur in a louse-infested community the disease might readily spread from person to person. The observations on Brill's disease strongly suggest that man serves as the reservoir for epidemic typhus between outbreaks just as the rat does in endemic typhus.

The complement fixation test now provides a tool with which surveys of the prevailing types of typhus in a region can be determined. This procedure has been applied and endemic typhus has been discovered in Jamaica and epidemic typhus in a South American country. These surveys are now being continued in other countries.

The author wishes to thank Captain S. C. Bukantz, Lt. K. Wertman, Lt. L. Pillemer and Miss N. Rogers for their assistance, as well as Dr. E. Schoenbach for having provided the specimens of serum from cases of Brill's disease.

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6 H. Zinsser, *Am. Jour. Hyg.*, 20: 513, 1934.

A STUDY OF CRYSTALLINE BEEF LIVER CATALASE DRIED IN THE FROZEN STATE[1]

INTRODUCTION

THE drying of proteins by the lyophile process is assuming increasing importance in research and in preparing such material as dried plasma or dried pollen extracts for practical use. There is a tendency to assume that in drying a quickly frozen protein preparation by subjecting it to a high vacuum, no change such as denaturation occurs. The following observations show that this is not necessarily true.

1 From the Department of Biochemistry and Pharmacology and the Department of Medicine, The University of Rochester School of Medicine and Dentistry, Rochester, New York.

They also indicate that lyophilization might be used in selected cases as a means to study the process of protein denaturation. Finally they make it appear possible that new information about the chemistry of an enzyme molecule may be obtained from a study of the lyophilized material.

EXPERIMENTAL

Twice-crystallized beef liver catalase,[2] consisting of a suspension of plates and prisms in water, was quickly frozen in a thin layer by cooling in an acetone-dry ice bath. Then a vacuum pump was attached and the preparation was removed from the cold bath and left connected with the pump until drying was complete. The frozen suspension did not melt at any time during the drying. A separate sample that was heated in the oven to 100° C for two hours did not change in weight.

The dried powder was suspended in water and was examined microscopically. Large crystals of the prism type were disintegrated, but the small crystals of this type retained their original form. The plates were fragmented. The dried preparation though insoluble in water was easily soluble in excess M/1,000 disodium phosphate. In concentrated suspensions it became soluble if sufficient disodium phosphate was added to bring the pH to 8.0. By this procedure, concentrated solutions were obtained which showed a slight opalescence and gave a very strong qualitative test for catalase. The usual three-banded catalase spectrum was present. Quantitative determinations however showed that the activity per dry weight of the material was only about one third that of undried crystalline beef liver catalase,[2] since the *Kat. f.* was about 11,000.

The solubility of the dried preparation differs from that of the undried material, since it is only slightly soluble below pH 8 in the presence of 10 per cent. NaCl. Moreover, it has not been possible to crystallize the dried material, either by the ammonium sulfate method[3] or by the dialysis method.[2] This indicates that a change has been brought about in the enzyme molecule, such as a mild denaturation. It is of interest in this connection that lyophilized catalase keeps quite well in a desiccator, but if left exposed to the atmosphere it gradually loses its solubility during a period of about two months and finally becomes quite insoluble and inactive.

The absorption spectrum of dried catalase was compared with that of undried catalase by Mr. Ralph Brauer of this Department of Biochemistry and Pharmacology, using a visual spectrophotometer. The two samples were adjusted in concentration so that the intensities of the bands at 630 mμ were equal. We have not yet determined whether following this procedure the concentrations on a dry-weight basis are equal. The two absorption spectra do not appear to differ significantly, as shown in Fig. I.

Dried catalase is inhibited by NH_2OH and HCN, as is undried catalase. In the presence of NH_2OH, the addition of a little hydrogen peroxide causes the appearance of the two-banded spectrum reported by Keilin and Hartree[4] for undried catalase. Dried

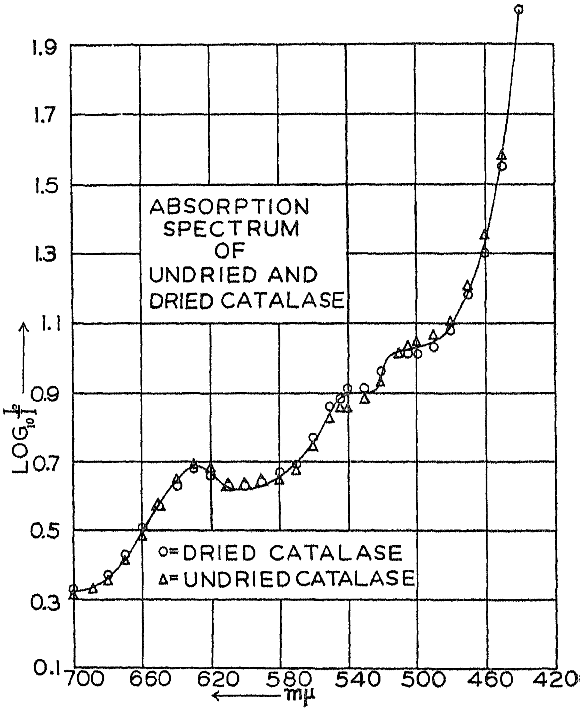

FIG. 1

catalase gives the same bands with HCN, as does undried. Thus the behavior of the dried catalase towards NH_2OH and HCN seems to be identical with that of undried catalase.

One of the peculiarities of ordinary undried catalase is that the hematin iron is not reduced by $Na_2S_2O_4$ alone. However, Zeile *et al.*[5] reported that they were able to reduce the catalase-H_2S compound with $Na_2S_2O_4$ after excess hydrogen sulfide had been removed by passing an inert gas through the solution. If oxygen were admitted and the solution shaken, the reduced catalase was oxidized and the original spectrum returned.

We have found that our dried catalase when in solution is reduced by adding $Na_2S_2O_4$ buffered at pH 7.5, as is shown by the two-banded spectrum

[2] J. B. Sumner and A. L. Dounce, *Jour. Biol. Chem.*, 127: 439, 1939.

[3] J. B. Sumner and A. L. Dounce, *Jour. Biol. Chem.*, 121: 417, 1937.

[4] D. Keilin and E. F. Hartree, *Proc. Roy. Soc. London*, B 124: 397, 1938.

[5] K. Zeile, G. Fawaz and V. Ellis, *Zeits. Physiol. Chem.*, 263: 181, 1940.

which appears, with a strong band at 560 mμ and a weaker and narrower band at 594 mμ. The dithionite can not be replaced by hydrogen sulfide or by a mixture of sulfite and bisulfite of neutral reaction. The two-banded spectrum given by reducing dried catalase with $Na_2S_2O_4$ is quite different from the two-banded hemochromogen-type spectrum which one obtains by adding $Na_2S_2O_4$ to a dried catalase solution which has been boiled. The latter shows bands at 560 mμ and 528 mμ, if light is made to pass through the precipitate which consists of completely heat-denatured catalase. This material of course is inactive towards hydrogen peroxide.

The two-banded spectrum of dried catalase treated with $Na_2S_2O_4$ is changed back to the original catalase spectrum on bubbling oxygen for a few minutes through the preparation, while the addition of a small amount of hydrogen peroxide causes the spectrum to revert instantly to the original catalase spectrum. The latter observation does not argue in favor of the mechanism of reaction of catalase with hydrogen peroxide proposed by Keilin and Hartree,[4,6] in which the iron was thought to be reduced by hydrogen peroxide and reoxidized by molecular oxygen. Dried catalase treated with $Na_2S_2O_4$ is qualitatively as active as dried catalase itself.

The behavior of dried catalase towards $Na_2S_2O_4$, which is probably its most interesting attribute, is summarized in Table 1, together with the corresponding behavior of undried catalase and boiled, dried catalase.

TABLE 1

Catalase Employed	Effect of Adding $Na_2S_2O_4$
Undried Crystalline Beef Liver Catalase	No Spectral Change
Dried Crystalline Beef Liver Catalase	A Two-Banded Spectrum Produced. Bands at 594 mμ and 560 mμ
Boiled, Dried Crystalline Beef Liver Catalase	A Two-Banded Hemochromogen-Type Spectrum Produced. Bands at 560 mμ and 528 mμ

DISCUSSION

A possible explanation for the reducibility of dried catalase is that whatever change has been produced in the catalase molecule by drying includes a sufficient loosening of the linkage between iron and protein to permit $Na_2S_2O_4$ to reduce the iron. The question may be raised as to whether all of the lyophilized catalase has been changed in some way, or whether two thirds has been changed and one third left unaffected. To settle this point with certainty, much work of a physico-chemical nature might be necessary, but the behavior towards $Na_2S_2O_4$ makes it appear probable that none of the enzyme has escaped at least some change. Otherwise, one would expect to obtain mixed spectra of unchanged catalase and $Na_2S_2O_4$-treated catalase. At the present time it seems probable that the change produced in catalase by drying in the frozen state is of the nature of a very mild denaturation.

Another question of importance is whether the change in the enzyme molecule really occurs during the drying or during subsequent solution. The loss in activity and development of insolubility, which evidently is produced by atmospheric moisture acting over a period of time, indicates that at least part of the change may well occur during solution of the enzyme. It is even possible that eventually one might find a way to dissolve the enzyme so as to obtain it in the original condition.

Finally, one might wonder whether drying amorphous instead of crystalline catalase would give different results. This has not yet been investigated, but a solution of recrystallized urease was frozen and dried to an amorphous powder which was found to be completely water-soluble immediately after drying. It showed a high qualitative activity; quantitative determinations were not run. On standing exposed to the atmosphere the material gradually became insoluble and lost most of its activity during a period of about three months.

It should perhaps be noted that the work reported here deals with highly purified proteins of relatively high molecular weight,[7,8] so that any conclusions which one may wish to draw do not necessarily apply to protein mixtures or to certain low-molecular weight proteins like heart-muscle cytochrome C, which can be dried without apparent change.

SUMMARY

Crystalline beef liver catalase has been dried by the lyophile process, and the properties of the dried preparation have been compared with those of undried crystalline beef liver catalase. The dried material is not crystallizable, possesses about one third the activity per dry weight of undried crystalline beef liver catalase, and in contrast to the undried material, its hematin iron can be reduced by $Na_2S_2O_4$ alone. It is thought that the process of drying, or the subsequent solution of the dried material, produces some change in the molecular structure such as a mild denaturation.

ALEXANDER L. DOUNCE
JOE W. HOWLAND

[6] D. Keilin and E. F. Hartree, *Nature*, 144: 787, 1939.

[7] J. B. Sumner and N. Gralén, *Jour. Biol. Chem.*, 125: 33, 1938.

[8] J. B. Sumner, N. Gralén and I.-B. Eriksson-Quensel, *Jour. Biol. Chem.*, 125: 37, 1938.

THE ENERGY COST OF STANDING IN HORSES[1]

THAT basal metabolism of the horse may be determined while the animal is standing is suggested by the fact that it appears to rest as comfortably standing as lying, and actually spends more sleeping time in the former than in the latter position. Resting metabolism data have been obtained on two pony mares trained from infancy to lie at command, and to tolerate a metabolism mask connected to a large spirometer of the Benedict-Collins type. While the difference is insignificant, metabolism of lying animals was found to exceed that of the horses in the standing position, as shown in Table I.

TABLE I

METABOLISM OF HORSES IN STANDING AND LYING POSITIONS

	Three year old filly Weight 700 lbs. (19 trials in each position)		Four year old lactating mare Weight 800 lbs. (9 trials in each position)	
	Standing	Lying	Standing	Lying
O_2 consumption, Cal/hr.	403.9 ± 19.8	432.3 ± 12.0	406.0 ± 40.2	448.3 ± 23.3
Ventilation rate, Liters/minute	86.8 ± 5.3	114.5 ± 2.9	69.9 ± 9.4	107.3 ± 3.7
Respiration rate, Resp./minute	13.3 ± 0.4	20.9 ± 0.5	11.6 ± 0.9	20.8 ± 1.1

The significant increases in ventilation and respiration rates observed in the lying position suggest that lying may interfere in some way with ease of respiration, and this in turn may increase metabolism. This, combined with the effect of the powerful suspensory and check ligaments which are doubtless an important factor in decreasing the energy cost of standing in horses, may explain the observation that metabolism of the horse is no higher, and indeed may be lower, in the standing than in the lying position. On the other hand, cattle and sheep, species which lack these powerful ligaments, exhibit an energy cost of standing of 10 per cent.[2]

The mares, on lying, usually assumed the characteristic position on one side of the chest in preference to that on the side with legs extended. Oxygen consumption ordinarily was determined once with the animal in the standing position, and once in a lying position on a given day. On some occasions the first determination was made with the animal in the standing position, while on other days this order was reversed. Lying down appeared to have no significant effect on pulse rate of the animals.

Since oxygen consumption of horses is no greater when the animals stand than when they lie, the latter position offers no advantage over the former in the measurement of basal metabolism.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SIMPLIFIED PHOTOMICROGRAPHY WITH A HAND CAMERA

THE relative ease with which good photomicrographs can be made, utilizing a box or folding hand camera and roll film, has not been generally recognized by visual microscopists, nor have the increased opportunities for making such photographs which are provided thereby because no darkrooms are required.

Most of the articles which have been published on simplified photomicrography recommend removal of the camera lens. The method described here consists in first independently focusing the microscope visually and then placing above (or behind) the ocular a roll-film or film-pack camera which has been focused at infinity or at another predetermined distance. Almost any type of personal camera can be used efficiently without mutilation and with the camera available immediately for other use. That the camera can be loaded in daylight and the films sent to the nearest drugstore for development and printing may be the chief advantages of the method to microscopists with no photographic facilities or experience.

The optical efficiency of this method is high if used properly; the definition of the pictures will be equal to that obtained with professional procedure and equipment. The optical considerations involved and the basis of the specific procedure that should be followed to obtain satisfactory results will be discussed more completely in a forthcoming article in a photographic journal. The Ramsden disk or eyepoint of the microscope should lie on the middle of the front surface of the camera lens ("vertex focus"), in which case the effective aperture of this lens is extremely small and the common optical aberrations become

[1] Journal Series number 849.

[2] Warren C. Hall and Samuel Brody, *University of Missouri Agricultural Research Bulletin* 180, 1933.

negligible. A simple one-element lens such as those of inexpensive cameras is actually preferable in this case. As the camera lens is withdrawn from the eyepoint so that an appreciable lens aperture is used, chromatic aberrations are the first to have influence, but are practically eliminated if a color filter is used. The image degradation increases more rapidly as the camera lens is lowered below the eyepoint, however, than when it is raised.

Focusing the Camera

Since most people accommodate somewhat in focusing a microscope it is preferable to set the camera focus at twenty-five feet rather than at infinity and a fixed-focus camera is quite satisfactory. With a focusable camera it is preferable to determine the correct distance setting for the individual by making a series of negatives. Some individuals place the images as close as ten feet, but the distance may be variable, especially with young people.

By far the best procedure is the use of a telescope with a cross hair or other graticule in its eyepiece which has been carefully set for the individual focus. The focus of the entire telescope can then be set for the distance setting of the camera, such as infinity, by focusing out of the window. If the microscope image is focused through the telescope, even though this over-magnified image seems very poor, every worker may obtain identically excellent photomicrographs. If used by only one person a crude and simple telescope will be satisfactory if it will stay in adjustment, since it need be focused only once. A very satisfactory instrument was made by holding a 48-mm microscope objective by a cork in a metal tube so that the normal front of the objective faced the other end of the tube. A homemade graticule was held in the tube by another cork and this was viewed by a magnifier from a dissecting stand at the other end of the tube. If a micrometer microscope ocular is used, the lower lens should be screwed out.

Magnification

Since the camera lens determines the bellows length, with a hand camera the magnification obtained in the picture is always a fraction of the apparent (or catalogue) magnification; with a Kodak 620, for instance, the magnification is one third of the objective × ocular value. The effect is to reduce the magnification of the ocular. Therefore, only high-power oculars are satisfactory for photomicrography with a hand camera, oculars of 25× or more being most suitable.

Disadvantages

Since the definition of the photomicrographic image properly taken with a hand camera is equal to that taken by more expensive and elaborate outfits, and the procedure is simple, there must be disadvantages that have prevented its widespread adoption. There are only three important ones.

(1) The camera lens must be scrupulously clean, since any dust or marks on the lens will appear on the negatives, enlarged and slightly out of focus. (2) When the lens is at the eyepoint the whole visual field of the microscope is taken so that the picture is surrounded by a ring of out-of-focus detail, whereas in photomicrography on a large bench only the central portion of the field is taken. Raising the camera restricts the field, but a slight loss in general definition also occurs. (3) The ease with which a flare spot is produced in the picture is the greatest disadvantage of this method. In some cases it is unavoidable. The bright back lens of the objective may be imaged on the negative as a spot of increased density. With most of the cameras tested the flare image was in best focus at the same camera height that gave best image definition, *i.e.*, with the vertex focus at the eyepoint. As the camera is raised, the flare spot goes out of focus fairly rapidly, but some definition is lost.

Where critical definition is not required the camera can be raised considerably above the eyepoint to control the last two defects.

Apparatus

For this method the camera must be supported independently of the microscope and have no contact with it. When a record is unexpectedly needed the microscope should be tilted horizontally and the camera blocked up behind it at the required distance and along the same axis.

A stable, convenient apparatus can be set up from regular laboratory equipment with relatively little labor and at small cost. The ordinary $\frac{3}{8}$- or $\frac{1}{2}$-inch laboratory support rod is not sufficiently sturdy. A commercially obtained 19-mm vertical support rod and base plate can, however, be used. The right-angle clamp should fit this rod with a round hole rather than a V groove. The whole device is illustrated in Figs. 1 and 2. The base plate can, of course, be screwed directly to a bench or table top. Three small pieces of felt or adhesive tape are stuck underneath the corners of this board to act as feet.

The camera support (D or E of Fig. 2) consists of a wooden block stapled to the top of a 7-inch laboratory extension ring support. For folding cameras a rectangular hole, having the same dimensions as the folding flap of the camera front, is cut in the center of the board. The camera can easily and quickly be pushed into the same position each time, using one end of the hole and a strip of wood at one side as guides. The face of the board and the side of the strip should be covered with cloth to protect the

camera. Two right-angle hooks are placed opposite each other at each end of the camera. The camera is fastened down firmly by slipping two wide elastic bands over the hooks. It can thus be removed for other use or replaced in a few seconds.

To support non-folding cameras, holes are drilled into the board to provide for protuberances on the face of the camera (support *D* of Fig. 2 was made for a Brownie).

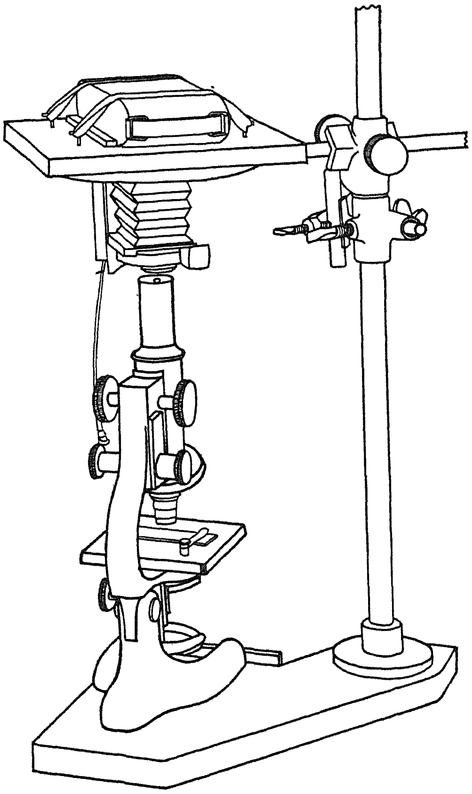

FIG. 1

By placing another clamp below the right-angle clamp that supports the camera ring, the camera can be swung out of the way when not in use. Moreover, by placing a short vertical rod (Fig. 2 C) as shown in Fig. 1, the camera is instantly realigned when its supporting clamp hits the vertical rod.

EXPOSURE CONTROL

The camera shutter is imaged on the field especially if the camera lens is slightly raised above the eyepoint, and this will vignette at very short exposure times to give apparent uneven field illumination. It is perfectly satisfactory when used with a watch on time exposures. A simple but satisfactory procedure for black-and-white pictures is to use a "blinker connection" such as is sold for Christmas-tree lights and to count the number of flashes to determine the exposure time.

DIRECTIONS

After the apparatus is set up and it is desired to photograph some specimen under the microscope, the procedure is as follows:

Determine the eyepoint of the microscope (illuminated disk of minimum diameter) with a piece of white paper.

Focus the camera at 25 feet or other predetermined distance.

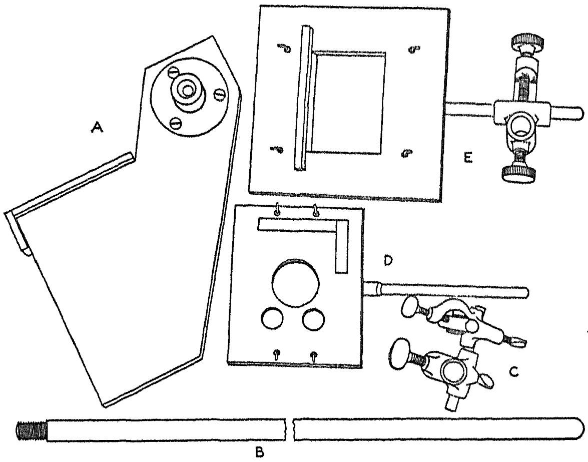

FIG. 2.

Lower the camera to make the front surface of the lens coincide with this point or be slightly above it.

Bring the lower clamp up to the other one and clamp it.

Loosening the upper clamp, align the camera lens with the ocular. This is best done the first time through the open back of the camera (containing no film) by looking through the lens. Tighten the upper clamp.

Rotate the lower clamp until the short vertical rod hits the upper clamp and again tighten it.

The camera can then be swung aside and a light-tight-connector attached to the lens.

Focus the microscope visually, preferably through a telescope.

Swing back the camera and take the picture.

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BOOKS RECEIVED

DRESCHER, ARTHUR B. and OTHERS. *Studies of Cenozoic Vertebrates of Western North America and of Fossil Primates (Contributions to Paleontology).* Illustrated. Pp. iii + 222. Carnegie Institution of Washington. Paper cover, $2.25; cloth binding, $2.75.

LLOYD, FRANCIS ERNEST. *The Carnivorous Plants.* Illustrated. Pp. xv + 352. Chronica Botanica, Waltham, Mass.; G. E. Stechert, New York. $6.00.

MAYR, ERNST. *Systematics and the Origin of Species.* Illustrated. Pp. xiv + 334. Columbia University Press. $4.00.

NEEDHAM, JOSEPH. *Biochemistry and Morphogenesis.* Illustrated. Pp. xvi + 785. Macmillan. $12.50.

WELCH, D'ALTÉ E. *Distribution and Variation of the Hawaiian Tree Snail Achatinella Apexfulva Dixon in the Koolau Range, Oahu.* Illustrated. Pp. 236. Smithsonian Institution.

SCIENCE NEWS

Science Service, Washington, D. C.

SCIENCE IN 1942

CHEMISTRY AND PHYSICS

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ELECTRON accelerator, whirling electrons up to 20,000,000 volts and producing x-rays of like power was completed, and a similar 100,000,000-volt machine is being built. A direct current x-ray generator operating at a potential more than 4,000,000 volts was developed.

An x-ray microscope has been devised which, by a photographic process, converts the usual diffraction pattern of a crystal into an actual picture of the arrangements of the atoms in one plane of the crystal.

New electron spectrometer, utilizing the varied slowing up of electrons passing through a specimen, produces a "spectrum" which aids in identifying the material, and supplements the electron microscope examination.

New ultra-fast oscillograph, with a beam sweeping at 18,000 miles per second, and timing to a few billionths of a second, records the wave form of transients, lightning flashes, and other oscillatory discharges up to 113 megacycles.

New scanning electron microscope makes use of television principles to examine opaque objects (not possible in the ordinary electron microscope), and reproduces the picture on a telegraphic facsimile printer.

An adapter has been devised which converts the ordinary electron microscope into a diffraction camera, so that in addition to the usual electron picture, the crystal or molecular structure of the specimen may also be determined.

Desk-size electron microscopes were developed, having simplified operation and much lower cost.

Chemical element 61, illinium, which does not occur in nature, was produced artificially by atomic bombardment with the cyclotron, but quickly disappeared by radioactive disintegration.

New measurements of the "proper" life of the mesotron gave it 2.8 millionths of a second in place of 1.6 millionths of a second previously estimated.

The proposal has been made to use the freezing point of benzoic acid, 122.37 degrees centigrade, for the standardization of thermometers.

Neutron pictures to supplement x-ray pictures showed certain advantages; neutrons were also employed in geophysical prospecting.

Synthetic cellulose was made for the first time.

Hydrogen fluoride was found to be a catalyst superior to aluminum chloride in the manufacture of synthetic rubber and of 100-octane gasoline.

Methods were found for making many kinds of oil out of any vegetable or animal fat.

By the use of fusel oil, alcohol was made from agricultural and industrial wastes without the expensive distillation process.

New solvents of the nitroparaffin class were developed for paints, lacquers and varnishes.

A solution of potassium, copper and arsenic salts has been found an effective means of retarding decay in telephone poles.

Color photography at night from high flying airplanes has been made possible by special filters and brilliant flash bombs of colored light.

Synthetic chewing gum was produced to replace chicle from tropical America.

Bread molds were found superior to malt in alcoholic fermentation.

ASTRONOMY

The first planet outside our own solar system was discovered, a satellite of an obscure double star in Cygnus, that is a sixtieth the mass of the sun and about 16 times the mass of Jupiter.

The brightest nova since 1918, Nova Puppis, rose to brilliance greater than first magnitude.

A remnant of Kepler's famous nova of 1604 was discovered as a small fan-shaped cloud.

A "Saturn" star, an intensely hot body surrounded by a luminous gas ring four times the diameter of our sun, was discovered.

S Doradus, a star 600,000 times brighter than our sun, was shown to be a double star, with each twin a giant.

Three or four mysterious spectral lines in starlight were explained by assuming that a substance impossible on earth, CH, or hydrogen carbide, exists in the so-called "empty" space between stars.

The mass of the moon was determined anew, this latest value making it 1/81.271 of the earth's mass.

A new "window" in the atmosphere was discovered when the observable spectrum in the infra-red region was extended to 24 mu.

The most powerful magnetic field measured in a group of sun-spots was recorded for the group visible to the unaided eye February 25 to March 1.

The reddest star ever photographed was discovered in the constellation of Monoceros.

A nova or exploding star was discovered in the constellation of Cygnus.

New comets discovered were Whipple, Oterma I, Oterma II.

New comets rediscovered were: Grigg-Skjellerup, Forbes, Schwassmann-Wachmann I, Wolf I.

A military version of the Schmidt camera-telescope went into war service as an aerial camera.

Pronunciations of constellations, stars, planets, etc., were standardized.

War time was adopted February 9 when all civil clocks were advanced an hour.

EARTH SCIENCES

In order to deprive the enemy of weather information, daily maps and forecasts were suspended by the U. S. Weather Bureau for the duration.

There were 40 earthquakes of sufficient strength to record themselves on distant seismograph instruments;

notable among them was a "family" of nine shocks in Ecuador at the beginning of July.

A gas well yielding pure nitrogen surprised its drillers in Wyoming.

A new device for sorting valuable particles out of low-grade tin ores and other minerals was developed.

Large-scale tests of sponge-iron production were undertaken in order to relieve scrap shortage in steel production.

A robot weather station, suitable for installing on mountaintops or uninhabited islands, was invented.

An unprecedentedly wet season kept some central areas of the country soggy during much of the summer, and caused some floods.

There were several severe tornadoes; one of them, in the Ozarks, killed 28, injured 200.

A storm-caused tidal wave near Calcutta drowned more than 10,000 persons.

No tropical storms of full hurricane strength reached the United States from the Carribean-Gulf region.

A new branch of geological science made its bow: paleogrostology, the study of fossil grasses.

An outflow of lava from Mauna Loa menaced the city of Hilo, but stopped before doing damage.

Biological Science

Crops of corn, wheat, soybeans and several other products broke all records, despite menacing farm labor shortages and early frosts.

An American scientific mission went to China to aid in improving agriculture and soil conservation there.

There was lively interchange of scientific personnel and information between U. S. A. and Latin-American agriculture.

The U. S. A. and Britain offered aid to the USSR in reconstructing agriculture in the "scorched earth" regions after the war.

Search for new sources of natural rubber included enormous expansion of guayule acreage, importation of hundreds of pounds of kok-sagyz seed from the USSR, efforts to organize collections of wild rubber in South and Central America, and planting selected seedling and grafted trees in the same tropical regions.

The four great regional laboratories of the U. S. Department of Agriculture concentrated efforts on war problems.

Day-and-night changes in temperature were found necessary for the production of fruit and seed by plants.

Tobacco mosaic virus kept 28 years in a bottle was found still able to produce disease.

The country-wide Victory Gardens movement was successfully carried through.

Domestic production was undertaken in many crops hitherto imported: hemp and other fibers, cork oak, drug plants, flavoring herbs, etc.

The number of plant patents passed 500.

Mechanization of beet sugar production was advanced by invention of a machine for planting treated seed, and of another to top harvested beets; both previously hand work.

Many new insecticides, both natural and synthetic, were tried, in search for substitutes for previously imported pyrethrum and rotenone.

A substitute for tapioca, both for food and "stickum" for stamps, was found in "Leoti" sorghum seed.

Thousands of sea birds became U-boat victims, killed by oil released from torpedoed ships.

Archeology, Anthropology

New Stone Age implements were found in the famous cave on Mt. Carmel in Palestine where only Old Stone Age records had previously been known, thus closing a long gap in the site's pre-history.

Cannibals and head-hunters in some South Sea islands reverted to old practices, due to removal of governmental controls and missionary influences by Jap invasion.

Despite a wartime spurt in the birth rate, the population of the United States is becoming stationary, statistical studies indicated.

No human artifacts were uncovered along the whole length of the new Alaskan Highway.

The smallest known normal human skull was found in an ancient cemetery in coastal Peru.

Psychology and Psychiatry

The number of brain cells in baby rats was increased artificially by injecting the mothers with pituitary growth hormones before the birth of the young, but their ability to learn was not increased.

A test for color aptitude has been prepared for evaluating workers in industries requiring accurate discrimination of small color difference.

Experiments showed that a change in the pitch of sound may be heard although there has been no shift in the point of maximal stimulation on the basilar membrane of the cochlea.

By stimulation of the eye with a barely perceptible electric current, it is possible to distinguish between blindness due to disease of the eye's retina and blindness caused by disease of the nerve.

Brain wave rhythms which are blocked out when the eyes see light can be used to detect cases of faked complete blindness.

By leaving intact a tiny isolated blob of pituitary gland and hypothalamus to maintain the water and sugar balance of the body, it was possible to discover that animals lacking 95 per cent. of the brain can walk, jump, claw and right themselves.

A single application of alum to the motor area of the brain made animals subject to repeated epileptic-like seizures when exposed to loud noise, apparently by permanent alteration of the brain cells.

Brain injuries resulting in spastic paralysis do not result in any characteristic personality traits, survey of 123 child patients revealed.

The character of brain activity, which changes with increasing age during the period of growth, was observed to continue to change toward the fast end of the brain frequency spectrum during adult life.

A monkey was taught to distinguish objects on the basis of such qualities as mobility and color, demonstrating a capability for this kind of abstract thinking.

(To be continued)

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ADDRESS OF THE PRESIDENT OF THE ROYAL SOCIETY[1]

By Sir HENRY DALE, C.B.E.

FULLERIAN PROFESSOR AND DIRECTOR OF THE LABORATORIES OF THE ROYAL INSTITUTION, LONDON

WE are to-day within a few weeks of the three hundredth anniversary of the birth of Isaac Newton. Wherever the progress of our Western science and philosophy has become effective, men will remember what that event was to mean for the world. Newton, as we shall hear, at the age of forty-three, when he had determined to abandon all further concern with natural philosophy, was induced at length, by Halley's friendly insistence, to give written form and system to the mathematical discoveries with which his amazing mind had been occupied over a period of some twenty years. The result was one of the greatest intellectual achievements in the history of mankind—the "Principia," providing for more than two centuries a framework for the mechanical interpretation of the universe and a basis for the building of physical science, and therewith of the material structure of our modern civilization.

We in Britain regard Isaac Newton as still, beyond challenge, the greatest of our men of science. Nor should the claim be limited to this island or to the British commonwealth of nations; for it was not till nearly half a century after Newton's death that former British colonists in North America began their development of an independent nation; and Newton is theirs as well as ours.

But, while we may proudly claim him as the countryman of all who share the birthright of the English tongue, the discoveries of science have belonged, and must belong again, to the whole world, and Newton's achievement is a part of the common heritage of all peoples. It can not be doubted that, if it had fallen in normal times, this tercentenary would have been

[1] Anniversary meeting, November 30, 1942.

marked by the greatest of international gatherings, in which men of science and philosophers from all the world would have assembled to do honor to Newton's memory. It would have been natural then to expect leadership, in such an enterprise, from the only two institutions which were intimately concerned with Newton's career as a man of science—Trinity College, in Cambridge, and this our Royal Society of London. Our two foundations did, indeed, confer as to the wisdom of attempting by joint action, even in this year of war, to arrange such a restricted and domestic celebration as the present conditions would allow. We agreed, however, to put aside such planning for the present, carrying it forward in our hopes to the time when a world at peace may be able to join in international commemoration of an event which has meant so much for all mankind. May the time be not too far distant.

To-day we are holding the two hundred and eightieth anniversary meeting of the Royal Society, on Saint Andrew's Day as by regular custom, ever since the first meeting on that day in 1662. It seemed to us that we should depart, on this occasion, a little from the usual order of our proceedings, so that, on a day so near to the tercentenary of his birth, our Fellows and our guests may be reminded of Newton. We have accordingly asked three of our Fellows to address the society on different aspects of Newton's work, in its relations to the science of the past and the present. We have asked Professor Andrade to give us the opportunity of understanding the magnitude of the change which Newton's work produced, in the conceptions of the material universe which were current in his own times. We know that to his contemporaries Newton's discoveries came as a great revelation, and we hope that Professor Andrade will help us to understand why they did so. We have asked Lord Rayleigh to deal, by demonstration where possible, with the experimental work of Newton and the great discoveries which he made by that method. This is an aspect of his greatness which popular estimates have tended to overlook; but I think that Lord Rayleigh will be able to convince us that Newton as an experimenter would have had claims to a place among our greatest men of science, even if he had failed, as he so nearly did fail, to write the "Principia." And, finally, we have asked Sir James Jeans to give us some reassessment of the validity and permanence of Newton's system, in relation to the immense advances of knowledge in our own times. There are many who have not the mathematical equipment to follow them in detail, who are nevertheless aware that revolutionary changes have been taking place in conceptions of the mechanics of the universe and of its ultimate material units. How is the Newtonian system affected by the discoveries which have required the general theory of relativity and the quantum mechanics at opposite ends of the stupendous scale? Is it being supplemented, modified or superseded after its centuries of dominance? We hope that Sir James Jeans will tell us; and we may remember, perhaps with comfort, that Newton's "Principia" seemed difficult and abstruse to his contemporaries, and that he even confessed that he had made it so deliberately, "to avoid being bated by little smatterers in mathematics."

Before I call on our chosen lecturers to address us, there are two other matters relating to Newton and the Royal Society, which it seems proper to mention here. In the hamlet of Woolsthorpe, near Colsterworth on the Great North Road, some six miles south of Grantham, there is still a modest manor farm-house, with a small orchard in front of it. Here the Newtons lived, simple yeoman farmers, and here, two months after his father had died, Isaac Newton was born, a puny, premature infant, on Christmas day, 1642, twenty years before the Royal Society was incorporated by the grant of its first charter. The house stands but little altered since that day. The room in which Newton was born has a simple marble tablet on the wall, inscribed with Pope's well-known couplet. But this house had importance in Newton's later life and in his work, and not only as his birthplace. It was here that he returned from his schooling at Grantham, at the age of sixteen, to take charge of the farm for his mother; and here, to the incalculable gain of science and the world, he showed such incompetence as a farmer that he was sent back to school, and thence to Cambridge. It was here, again, that he returned in the autumn of 1665, when the plague drove him from Cambridge; and here, during the following eighteen months of quiet exile in the country, his early ripening genius grasped already the essential principles of his major theoretical discoveries. You can still see the upper chamber which he then used as a study; and in the little orchard there is an old, recumbent apple tree, which, they will tell you, is descended by direct grafting from that which Newton saw. The land which Newton's family farmed is rapidly being laid waste, alas, by quarrying for ironstone; and soon there will be little left unspoiled save the orchard and garden round the house. It has seemed to us that, in this year of commemoration, something should be done to preserve for posterity a house and garden which carry such momentous memories, and which have meant so much for science. We have accordingly formed a small committee, in which Sir John Russell and Sir James Jeans have joined with the officers of the Royal Society; and we are in negotiation with the lord of the manor as to the possibility of acquiring this now tiny but historic property, so

that it may be put for as long as possible beyond the risk of damage or decay.

Then I think that it is our special duty here, at this anniversary meeting, to remember that, while Newton's great discoveries belong to the world, they came to publication through the Royal Society, and that Newton occupied its presidential chair for the last twenty-four years of his long life. Though his "Optiks" was not published till after he had become president, his original work for science was practically finished by the time of his election, and he had for some years been master of the Mint. There can be no doubt, however, that the wide fame of his achievements, and the respect and admiration in which he was everywhere held, did much, at a critical period in its history, to establish the prestige of this society in the eyes of the world. Let us then remember to-day that Isaac Newton, the greatest man of science of our race, was also the greatest of the Royal Society's presidents.

AWARD OF MEDALS, 1942

The Copley Medal is awarded to Sir Robert Robinson. He is recognized in all countries as one of the world's leaders in organic chemistry, and is one of the greatest and most versatile of investigators in that department of science. His researches, with a long and notable succession of pupils and collaborators, have covered a remarkably wide range of problems in this field, and his approach to these have been distinguished by brilliance in conception and a genius for the selection of methods leading to the desired solutions.

Robinson's investigations have been particularly concerned with the chemistry of natural substances, products of the life processes of plants and animals. His work has thus been a potent factor in the tendency of organic chemistry to return, in recent years, to an objective nearer to that of its origin, and to make contacts of growing intimacy and value with biochemistry, a more recent development in response to the stimulus of functional biology.

This occasion does not permit any attempt at a complete or detailed survey of all the different fields which Robinson's work has illuminated and opened to further exploration. Special mention must be made, however, of his long series of fundamental investigations on the constitution and relationships of the plant alkaloids. His theory of the biogenesis of plant products seems rather to have inspired than to have resulted from his own early and elegant synthesis of tropinone; and it has revealed an unforeseen and coherent relationship between the constitutions of different groups of alkaloids, and given a great stimulus to work on their synthesis. The work published from Robinson's laboratory has been fundamental to understanding of the isoquinoline and the indole series of alkaloids, of morphine and its allies, and of the structural formulae of strychnine and brucine, which formed the subject of his Bakerian Lecture.

Of at least equal scientific rank is the work which Robinson carried out and inspired over many years on the anthocyanin and, more recently, on the anthoxanthin pigments of plants, culminating in the synthesis of the actual coloring matters of flowers, and forming as a whole one of the most brilliant achievements in the whole range of modern organic chemistry.

Robinson's mastery of synthetic resources, and his penetrating instinct for clues to organic constitution, have been further demonstrated in a more recent approach to the synthesis of the steroids, in the production of series of compounds of interest for chemotherapy, and in notable studies of individual natural substances of a range of other types. He is, moreover, a philosopher as well as a master of experimental possibilities; and his theory of organic reactions, in the modern, electronic terms of valency bonds, has had a great influence on the development of fundamental conceptions in organic chemistry.

The Copley Medal is the highest recognition of scientific achievement in the Royal Society's gift, with no limitations of subject or nation; and the society may well find cause for satisfaction in the knowledge that the award of its premier medal for achievement in organic chemistry, after an interval of many years, finds among its own Fellows a recipient of such unquestioned preeminence as Sir Robert Robinson.

The Rumford Medal is awarded to Dr. G. M. B. Dobson. The Rumford Medal awarded by the Royal Society was established for the recognition of important discoveries made in Europe, especially on heat or on light. These conditions appear to be met with a special fitness in the award of the medal this year to Dr. G. M. B. Dobson, for his meteorological researches and discoveries. For Dobson's work has, in recent years, greatly extended knowledge of the linkage between the behavior of ozone and cyclonic disturbances, in that complicated heat engine which is the earth's atmosphere; while light may be said to have provided the basis of measurement for Dobson's spectrographic studies of the distribution of ozone, in time and in height above the earth's surface. Light had also a major concern in earlier researches on meteors in which Dobson collaborated with Professor Lindemann (now Lord Cherwell); in these, the study of the heights between which meteors become luminescent enabled them to draw conclusions as to the density, and from these as to the temperature of the atmosphere at great heights from the earth's surface. But it is especially on Dr. Dobson's own studies of the

ozone of the atmosphere, continued over many years and producing results of outstanding importance for meteorology, that the award is based.

A Royal Medal is awarded to Professor W. N. Haworth, a brilliant leader in organic chemistry. Haworth's great claim to distinction arises from the revolutionary change which has been produced by his own investigations, and by those of his immediate pupils, in the whole aspect of an important section of organic chemistry, dealing with the structure and the relationships of the carbohydrates. The ring structure of the simple sugars, first proposed by Tollens and supported by the work and the authority of Emil Fischer, had been generally regarded by chemists as firmly established. Detecting insecurities in the arguments which led to this formulation, Haworth developed the methylation technique, first used by Purdie and Irvine, and applied it systematically to the monosaccharides. He was thus able to show, by unequivocal methods of organic chemistry, that the accepted ring structure of these sugars was incorrect, and that, in their normal and reactive forms, they were derivatives of pyran and of furan, respectively.

Later Haworth further developed his methods in application to sugars and carbohydrates of increasing complexity. By his work, and that of others who have followed his lead, the detailed structures of many disaccharides and of some trisaccharides have been established. Progress has further been made in his attack on the structural complexities of the polysaccharides, and a simple chemical method has been evolved for determining their minimal molecular weights. Professor Haworth's work, in the field which he has thus made his own, has received the high international recognition of a Nobel Prize, and will assuredly take rank as a major achievement of permanent significance in chemical history.

A Royal Medal is awarded to Dr. W. W. C. Topley, who is one of the most distinguished of the British bacteriologists of recent years. The most important of Topley's contributions to bacteriology and experimental medicine has been the experimental study of epidemics, which he initiated and of which the methods have been largely his own creation. Much had been learned by the statistical analysis of observational data, dealing with the origin, spread and development of natural epidemics, under conditions largely out of control. Topley conceived the idea of applying such methods to the investigation of epidemics started artificially in populations of healthy mice, kept in the laboratory under conditions which could be exactly controlled and deliberately varied. Thus the factors conducive to the rise, culmination and decline of an epidemic, to its revival or its final subsidence, could be experimentally determined. In a long series of such studies, the important results of which were reviewed in his Croonian Lecture for 1941 on "The Biology of Epidemics," Topley had the statistical cooperation of Professor Major Greenwood, in both planning and interpretation.

On this firm basis of knowledge concerning the incidence and mortality of a naturally transmitted infection in untreated stock, the efficiency of prophylactic measures could be put to a controlled test. Under Topley's guidance and inspiration, accordingly, substantial progress had been made by his chemical colleagues towards the isolation from various species of pathogenic bacteria of highly purified and stable antigens, and the practical trial of some of these was interrupted by the outbreak of war.

Dr. Topley's researches have had a great and lasting influence on the study of bacteriology, immunology and epidemiology in relation to human medicine. His recent change of the focus of his interests may be expected to give an important stimulus to advance in many cognate fields of agricultural research.

The Davy Medal is awarded to Professor C. N. Hinshelwood for his work on the kinetics of chemical change, characterized by its pioneering quality and by the varied new lines of research which it has opened up. An experimental investigator of great skill and achievement, Hinshelwood has also enlarged the theory of the subject by able mathematical analyses and descriptions based on the concepts of collisions and of activation energy.

Hinshelwood took a leading part in the early study of homogeneous gaseous reactions. As the result of the examination of a number of bimolecular examples he was able to show, with reason, that these are confined to molecules containing few atoms, and that the actual rate was given by the product of the total collision rate and the probability of a molecule possessing the experimental energy of activation. Unimolecular reactions were found to occur with polyatomic molecules and to show more complex features. In association with Professor Lindemann (now Lord Cherwell), Hinshelwood put forward the mechanism, now accepted, whereby a reaction fundamentally dependent on collisions may nevertheless have unimolecular kinetics. This theory he was able to verify by showing that the rates of such reactions diminish at low pressures and that the kinetics then become bimolecular.

In the field of chain reactions Hinshelwood opened up new lines of advance by studying the thermal reaction between hydrogen and oxygen. Thus he discovered, and offered clear explanations for, the curious phenomenon of "explosion limits," confining explosive reaction, at any fixed temperature, sharply to a particular pressure region. Elaborate studies of the

effects of nitrogen peroxide and other foreign gases on the hydrogen-oxygen reaction brought to light the very great kinetic complexities of an apparently simple type of chemical change. In this work Hinshelwood drew attention to the influence of the container surfaces on chain reactions, and also clarified the confusion of evidence concerning the effects on reaction rates of the intensive drying of gases. He discovered the inhibition of certain gaseous reactions by nitric oxide and interpreted the effect as due to the removal of radicals from, and the suppression of, "chains."

Hinshelwood has also carried out a large number of experiments on heterogeneous reactions and shown that their differences in kinetic behavior can be explained by the application of the concepts of Langmuir.

Throughout all these researches, carried out with the utmost economy and directness, though with full experimental precautions, and interpreted in the most lucid manner, Hinshelwood has never lost sight of the essential complexity of chemical reaction mechanisms. He has always been ready to modify his views in accordance with new experimental evidence and to make the fullest use of the more recent developments of wave-mechanics and of statistical mechanics. Summarized by their author in two well-known treatises, Professor Hinshelwood's distinguished researches furnish abundant ground for the award to him of the Davy Medal.

The Darwin Medal is awarded to Professor D. M. S. Watson, preeminent among paleontologists for his contributions to knowledge of the course of vertebrate evolution. His researches have been concerned mostly with the origin of the land vertebrates, with the fishes most nearly related to them and with the main line of evolution leading to the mammals.

It will not be possible on this occasion to survey Watson's work in all its aspects, and mention must be restricted to some of the major lines of advance which it has opened. His Croonian Lecture, in 1925, summarized the conclusions which he had reached by that date as to the evolution of the Amphibia, demonstrating for the first time the relationship of the Stegocephalia to the Osteolepid fishes.

In addition to tracing the descent of land vertebrates thus from Amphibia back to fishes, Watson followed the line of the evolution of the mammals, through early, primitive reptiles, the Cotylosaurs, to the mammal-like reptiles, in a large series of valuable papers. He related this work on the reptiles to that on the amphibians in a paper on the evolution of the shoulder girdle of the Tetrapoda.

In this work on the fossil vertebrates, in its relation to the course of evolution, Watson has not confined his attention to morphological details, but, with an enterprise remarkable in a paleontologist though characteristic of his outlook, has considered where possible the functional significance of the structures preserved in the rocks; as in the paper in which he considers the mode of action of the shoulder girdle and deduces the nature of the musculature of a group of marine fossil reptiles.

Pursuing his study of mammalian origins, Watson was led to study the most primitive of living mammals, the oviparous Monotremes, and to discover that characters in which their skulls differ from those of other mammals can be regarded as extreme developments of features observed in the skulls of certain fossil, mammal-like reptiles.

Watson's work has continued in full vigor into recent years, and has brought two further contributions of major importance to the study of evolution in the vertebrates. One is concerned with the origin of the frogs from more primitive amphibian types, while the other shows that a group of fishes from the Old Red Sandstone constitute a separate class of vertebrates, equal in rank to and ancestral to the remaining fishes.

Tracing, in this brilliant series of researches, the main stages of the descent of the mammals from their earliest fish-like ancestry, Professor Watson has certainly performed "work of acknowledged distinction in the field in which Charles Darwin himself labored."

The Buchanan Medal is awarded to Sir Wilson Jameson, formerly dean of the London School of Hygiene and Tropical Medicine and since 1940 the chief medical officer to the Ministry of Health and the Board of Education. In both capacities Jameson has shown himself to be a man of stimulating influence and leadership, determined and persistent in his efforts to ensure that advances of medical knowledge in the laboratory, the clinic and the field shall receive prompt application in administrative practice.

Largely to Jameson's vigorous policy is due the hope that active immunization against diphtheria, which has banished the disease from many large communities of North America, will at length find systematic and effective application in this country, where many of the discoveries were made which have rendered it safe and practicable. In the prompt official adoption of methods using modern technical resources, to deal with the recent increase of tuberculosis under war conditions, and in the recognition of adequate and scientifically planned nutrition of the people as a central item of an effective health policy, Jameson's active and enlightened influence can again be discerned.

Of the grounds on which the founder of the Buchanan Medal desired the awards of it to be made, Sir Wilson Jameson's high claim to it is based on "administrative and constructive work" of outstanding merit in the service of hygienic science.

The Hughes Medal is awarded to Professor Enrico Fermi, now of New York. Professor Fermi has made most notable contributions both to theoretical and experimental physics. In the early days of the modern quantum theory he was one of the first theoretical physicists to appreciate the generality of the considerations put forward by Pauli and known as the exclusion principle. This led him to discuss the statistical theory of a perfect gas of particles in equilibrium, obeying this principle, with results which were obtained independently and almost simultaneously by Dirac by similar methods. These results of Fermi and Dirac are of the utmost importance in the modern theory of assemblies of similar particles, such as electrons, protons and neutrons. Following this outstanding personal contribution, Fermi played a great part in building up at Rome a distinguished school of theoretical physics, where he himself made one of the earliest successful attempts to construct a theory of radioactive β-ray change. This theory shows the most profound insight into the theoretical nature of the quantum theory.

His interest in the atomic nucleus led Fermi naturally on to his experimental studies in this field. Immediately after the discovery of the neutron he realized that it provided a new possibility of attack on the nucleus and of stimulating nuclear change by neutron bombardment. This work opened up the fruitful modern field of study concerned with the transformations of nuclei of medium and great atomic number, and led directly to the most exciting transformations of all, the nuclear fission of uranium and thorium.

Professor Fermi's work is characterized throughout by profound insight and great experimental skill. In the fields which he has made his own he is universally acclaimed a leader.

CRISIS IN RUBBER[1]

By JOHN L. COLLYER

PRESIDENT, THE B. F. GOODRICH COMPANY

IT is a pleasure for me to meet with members of the Academy of Political Science. I feel honored and privileged to acquaint you with certain facts pertaining to the all-important question of rubber—natural and man-made.

America is in the grip of a rubber crisis. Our country, which normally uses more than half of all the rubber that is consumed throughout the world, has been shut off by decisive enemy action from sources which formerly produced 90 per cent. of the world's rubber. We are now engaged in a grim race against time. Several hundred thousand tons of new rubber will shortly be urgently needed to manufacture the wide range of war products required by the armed forces of the United Nations and to keep our vital industrial plants and essential transportation functioning.

The crisis that we face resolves itself into a question of whether we can bridge the gap until synthetic rubber manufacturing facilities now under construction within our country's borders are producing the huge quantities of this indispensable material that we will need to win the war.

It seems odd that we should be faced with a crisis in rubber when we stop to consider that rubber originated right next door to us in South America where native or wild rubber trees are situated. The seeds from which the extensive Eastern plantations have sprung were collected in South America in 1876. But by 1900, no more than 10,000 acres have been planted in the East.

The rubber plantations of the world now covering a planted area of approximately 9,000,000 acres have had in 1941 a productive capacity of 1,600,000 tons a year. The world's consumption in 1939 through 1941—a record three-year period—was at the rate of about 1,100,000 tons a year, which left a potential surplus of 50 per cent.

It has been my privilege to have visited the Eastern plantations and to have witnessed rubber manufacturing in most parts of the world, including Germany and Japan. In the course of many visits to Germany during the 1930's, I observed at close range the development of an imposing synthetic rubber industry as the Nazis prepared for war that is now resulting in the greatest death and destruction known to mankind.

During the war of 1914–1918, Germany had an inferior synthetic rubber. Research and development work—started at that time—has been diligently continued and intensified ever since. To-day Germany is probably living at least 75 per cent. on synthetic rubber.

Based on what I learned in Germany and Japan

[1] Read before the Academy of Political Science, New York, November 10, 1942.

and what I had become convinced were the aims and policies of the Nazis and the Japanese militarists, it has since 1937 been my belief that our country could not afford to be without a national insurance policy in terms of rubber. The only alternative was to have our entire national economy continually threatened by the possibility of disruption of the long rubber life-line to the Far East.

In June, 1940, the stock of rubber in the United States totaled only 168,000 tons. The consumption for the year 1940 was 648,000 tons. The position of about three and a half months' stock was anything but a healthy one for our country and for its economy.

This precarious situation could be corrected only by a two-point program. To make certain that a continuing supply of rubber would be obtainable, new and dependable large-scale sources of rubber had to be created quickly here at home. And meantime, the accumulation of reserve stocks would provide a temporary bank on which to draw until American-made rubber could meet the nation's requirements.

In early June, 1940, knowing that rubber was too vital a material to be left to chance, the B. F. Goodrich Company decided to take action. At a reception in New York nearly two and one-half years ago we introduced for sale to car owners a tire in which American general purpose synthetic rubber replaced natural rubber by more than 50 per cent. This American man-made material was developed by our organization after a research program which was started in 1926, and was even then in 1940 being commercially manufactured in our own plants.

Although we felt and so stated at that time to the Senate Military Affairs Committee that synthetic rubber could be produced on a large scale at a cost of approximately 25 cents a pound, yet we knew that large-scale production of synthetic rubber could not be justified on an economic basis by industry.

Industry had to take a long-range view, remembering that as recently as 1933 crude rubber sold in New York at less than three cents a pound. The 1940 current market price of 20 to 22 cents a pound was artificial, having been brought about by restriction of production of plantation rubber and by war uncertainties. We knew that a cent a pound variation in the price of rubber amounted to approximately $14,-000,000 a year based on a consumption of 600,000 tons a year.

Without artificial production restrictions, natural rubber in normal times might have a price advantage of 10 to 15 cents a pound, based on known processes of manufacturing synthetic rubber. This might mean a difference of from $135,000,000 to $200,000,000 a year, or certain disaster to private capital invested in general purpose synthetic rubber plants.

But our company pressed on and sold quite a few of those synthetic rubber tires—in 1940—several thousand of them—to cooperative firms and individuals who were willing to pay a higher-than-market price to help us get an American general purpose synthetic rubber program started. And we did accomplish the two main objectives that we had in view at that time. Our announcement focused the attention of the nation on our critical rubber supply situation, and we believe that we challenged the scientists throughout the country to increased efforts in the whole synthetic rubber field.

Shortly after this step by our company in June, 1940, our government took constructive action. Plans were put into effect for purchasing large reserve stocks of rubber. Under this arrangement the British and Dutch plantations removed the restriction of output bans and produced at capacity.

We had recommended the construction of two or more government financed large-scale synthetic rubber plants by competitive industrial organizations.

But synthetic rubber seemed at the time too revolutionary a step for prompt action on such a scale. A great potential capacity on the other side of the world for growing natural rubber was available, and the cost of creating synthetic rubber plants was admittedly high when figured in dollars.

Two and a half years ago before advocating American standby synthetic rubber plants as the only practical solution, we had given full consideration to other sources of rubber supply.

Our good neighbors, the South American countries, could then provide little more than 5 per cent. of our peacetime requirements for rubber. Six or seven years are required to grow a rubber tree ready for tapping. It was estimated that it would take ten or more years for South America to supply substantially more rubber through increased planting.

Africa was then supplying less than 1 per cent. of the world's rubber, and even if that continent produced sufficient quantities, we would again be depending on another hemisphere.

Guayule, a shrub grown in Mexico and southwestern United States, and supplying less than 1 per cent. of America's consumption, was investigated. Our company has used guayule for more than 30 years and has been the largest consumer in the world of this type of natural rubber. Guayule is a serviceable rubber, but with the seeds then available, the time of growing would be too long for increased planting to meet the emergency that faced us. 75,000 acres of guayule are being planted by the United States government, but in all probability these will not be harvested until 1945, when 50,000 or more tons should be obtained.

But none of these sources of rubber was in 1940 or

in 1942 prepared to supply our emergency demands. Synthetic rubber, a product of American science, was then and is to-day our hope.

It was not until the bombs fell on Pearl Harbor that a large-scale synthetic rubber program was announced by our government—400,000 tons a year—authorized in January, 1942. Unfortunately at that time no over-all planning of structural materials, equipment and raw materials had been carried out.

Hindsight is always easy, and it is readily understandable why the vast majority of people, even some of whom had spent a lifetime in rubber, did not foresee during 1940 and 1941 the possibility of the rapid-chain of events which have since deprived us of 90 per cent. of our rubber supply.

But that is water over the dam. It is not the past but the future which will determine our fate.

The January, 1942, authorization of a total capacity of 400,000 tons a year of butadiene synthetic rubber just mentioned, estimated to cost $400,000,000, has since been increased and the present program is made up of plants designed to produce 705,000 tons of synthetic rubber of the butadiene-styrene type, 132,000 tons of butyl rubber and 40,000 tons of neoprene, or a total of approximately 900,000 tons a year, with an estimated plant cost of $700,000,000. In addition, Canada is carrying out a program for creating a capacity of 40,000 tons a year of the butadiene type synthetic, and I believe that Russia has been producing as much as 50,000 tons a year.

Our company has recommended that we refer to the butadiene type rubber as AA (Pronounced—Double A), an abbreviation for All-American. We object strenuously to calling this new rubber by the German name Buna. The AA rubber, as we term it, will be produced in plants designed, constructed and operated by American engineers and will be made by a process incorporating the best features of the All-American research and development of the companies participating in the program.

Undoubtedly you would like to know something of how AA rubber is produced. The basic raw materials are three parts of butadiene and one part of styrene. Butadiene is a gas which can be made either by cracking petroleum, or by removing hydrogen from butylene, a by-product in the manufacture of high octane gasoline, or by catalytic conversion from alcohol. No matter from what basic raw material it is prepared, the resulting butadiene when properly purified is the same. The other raw material styrene can be most conveniently manufactured from the aromatic hydrocarbon benzene obtained from coal tar and ethylene, a gas which occurs as a by-product in most petroleum refineries.

The responsibility for the construction and operation of the plants to produce the butadiene and styrene to be used in the manufacture of All-American synthetic rubber has been delegated to the petroleum and chemical industries.

To the rubber companies has been given the task of building the polymerization or synthetic rubber plants and of producing AA rubber from raw materials supplied to them mainly by the chemical and petroleum industries.

In the polymerization process, butadiene which has been liquefied by compression and cooling is mixed with styrene, soapy water and several minor "salt and pepper" ingredients. This mixture is then heated and stirred under pressure, whereupon the molecules of butadiene and styrene polymerize or join together to form an emulsion of synthetic rubber which is quite similar in appearance to the latex obtained from rubber-producing trees. From here on the process of obtaining sheeted rubber is like that used for natural rubber.

Already much that is good and several things that are bad have been discovered about the usefulness of this new rubber. Test tires whose rubber content is 99.84 per cent. of this synthetic rubber are running on the highways in various parts of the country. Passenger car tires and small-size truck tires give excellent service. However, when we come to the manufacture of large-size truck and bus tires urgently needed for military use, several difficult problems arise due to the fact that synthetic rubber tires in service generate more heat than natural rubber tires, thus causing an earlier failure. We are now hard at work on this problem and we are confident that it can and will be solved as we gain more experience in the field.

Even now, almost all essential rubber articles can be made from AA rubber including hundreds of important rubber products used by the armed forces of our nation.

When will the production of this man-made rubber fully meet our necessary requirements? Certainly not until 1944. Compared to our consumption of 765,000 tons of rubber last year, we shall produce about 32,000 tons of American-made rubber this year, practically all from privately financed plants.

In 1943 the government plants will come into big production and estimates for all types range from 300,000 to 500,000 tons, and in 1944, from 700,000 to 1,000,000 tons.

This tremendous program for man-made rubber in quantities sufficient to meet our vital requirements must be fulfilled or the nation will, in a matter of months, be confronted with a critical situation highly dangerous to our military forces and our whole civilian economy. We must have rubber to win this war.

Late 1943 will see our stocks of rubber, and those of our Allies, near exhaustion.

It is imperative that we have the utmost speed in building and equipping the giant plants and in the actual production and use of man-made rubber. Every day lost now means irreplaceable loss of rubber, for we are living on our fat. And our fat is rapidly disappearing.

The construction of the government synthetic rubber plants is one of the most highly technical and complicated engineering jobs of all time.

Several hundred thousand tons of critical materials will be used. These materials necessary for the construction of the plants and equipment must be made available promptly or there will be further serious delays in completion of the production facilities so urgently needed.

Thousands of skilled mechanics, pipe fitters, electricians and construction workers are required, and I feel that unusual measures will be necessary to make them available when needed.

We must have enough rubber in time and not too much too late.

Mr. Jeffers, our rubber administrator, and his organization are working day and night on every phase of the problem and particularly on structural materials and man-power.

I have said that the real crisis in rubber will come next year. How well we shall meet and pass the 1943 crisis will depend mainly upon our ability to conserve rubber and to produce synthetic rubber. This statement of fact is made clear in the constructive and timely Baruch committee report which I feel would provide extremely interesting reading to members of the Academy of Political Science.

The Baruch committee, while critical of the handling of the rubber problem, did report encouraging progress in synthetic rubber, as for example the following, which I quote:

> Our committee is convinced that the government's present program is technically sound. From this time on, the important thing is to get on with it without delay. . . .
>
> It is our firm conclusion that present processes for manufacturing synthetic rubber and raw materials required must not at this late date be changed unless new processes can be shown beyond peradventure to have such advantages over these now employed that more rubber would be obtained in the ensuing months than would otherwise be the case. We have found no such process in the course of our investigations.

I think it is important that we consider another statement made in the Baruch report. Again I quote:

> Probably the most interesting and satisfying part of our study is the confidence we have acquired in the men from the industry who have the plans in hand and who are satisfied they can lick the problem in the given time. Their competence and experience, their resourcefulness and ingenuity, are the best guarantees that we can do so.

The stark fact that lack of rubber could cost us this war is clearly stated and fully explained in this enlightening report which should be a constant reminder to us that we must never again become wholly dependent on distant sources of rubber supply.

Fortunately, thanks to the farsightedness of our government, we had, when the Eastern plantations were captured, approximately 600,000 tons of rubber, which is a normal year's supply for our country. I mentioned that in June of 1940 this total was only 168,000 tons. Our stocks of crude rubber and that contained in finished products, as well as our stocks of scrap rubber and reclaimed rubber, must bridge the gap until synthetic rubber becomes adequate for military and other essential needs.

Rubber in tires on cars now on the nation's highways actually constitutes the largest stockpile of rubber in this country—approximately 1,200,000 tons—or nearly double our total crude stocks at the beginning of this year.

The Baruch committee in recommending mileage rationing recognized the absolute necessity to our war effort of keeping all cars in operation for essential driving.

We in B. F. Goodrich feel now as we have for the last two years that all cars are essential cars, but that all driving is not essential driving. The government now has a program to convert that basic fact into a nation-wide conservation habit.

The purpose of the rationing program which is scheduled to begin nationally November 22 is to insure on a fair and just basis the operation of all passenger cars for essential driving with a minimum consumption of rubber, reclaimed rubber and rubber substitutes.

I am confident that we shall all respond with good spirit to the requirements of the mileage rationing program until synthetic rubber becomes available in quantity for civilian use.

I am informed that the 35-mile speed law now a national regulation is being splendidly observed. Sales of gasoline in unrationed areas have already sharply decreased, reflecting a reduction in mileage that is startling only to those who underestimated American willingness to make personal sacrifices if they will help to win this war. That to me is most heartening. It proves that the American people will respond even to bad news if they know fully what is required of them.

This war, more than any other war in history, is a conflict of materials and resources, as well as a battle of men. Rubber is one of the strong and versatile

threads that we must weave through the fabric of our industrial production and transportation systems to supply and maintain our modern armies and navies.

By contributing to the solution of America's rubber crisis, each one of us will do a wartime job of No. 1 importance. Any circumstance or any policy that prevents the effective functioning of our home-front industries and essential civilian transportation can be just as disastrous to our war effort as a defeat in battle.

Our gallant fighting men know that courage alone is a thin weapon against Axis planes and tanks. They look squarely to our country to deliver in time and where needed superior weapons and equipment—weapons and equipment which require thousands of tons of rubber.

The design, construction and capacity operation of our many giant synthetic rubber plants—in time—will be one of the greatest industrial achievements of all time. Conservation of rubber must bridge the gap until our rubber problem has been solved.

Industry is supremely conscious of its part in this grave responsibility, and the American people are now fully conscious of their own important role.

SCIENTIFIC EVENTS

RECENT DEATHS

DR. GARY N. CALKINS, emeritus professor of protozoology, of Columbia University, died on January 4, in his seventy-fourth year.

DR. DAVID M. LICHTY, who retired in 1932 from an associate professorship of chemistry at the University of Michigan, died on December 24, at the age of eighty years.

THE death is announced of Alfred Nelson Finn, for many years chief of the department of optical glass of the National Bureau of Standards, at the age of sixty years.

DR. JAMES EDMUND IVES, until his retirement in 1936 senior physicist of the U. S. Public Health Service, died on January 1, of injuries received when struck by a street car on New Year's Eve. He was seventy years old.

DR. ANDREW H. PALMER, who from 1914 to 1924 was a meteorologist of the U. S. Weather Bureau and was later superintendent of crops and weather insurance of the Aetna Affiliated Companies, San Francisco, died on December 26, at the age of fifty-six years.

DR. PURNENDU NATH CHAKRAVORTY, a native of India, research chemist with the Upjohn Company and formerly associated with the department of chemistry at Princeton University, was killed in a railroad crossing accident on December 23. He was thirty-seven years old.

HARVEY L. WESTOVER, senior agronomist in charge of forage crop investigations in the Bureau of Plant Industry of the U. S. Department of Agriculture, known for his work with alfalfa, died on January 2, at the age of sixty-three years.

FREDERICK DIXON CHESTER, chief chemist of the Mimex Company, Long Island City, died on January 1, at the age of eighty-one years.

DR. E. J. ALLEN, from 1895 to 1936 secretary of the Marine Biological Association of the United Kingdom and director of Plymouth Laboratory, died on December 7 at the age of seventy-six years. The Linnean Gold Medal was awarded to him in 1926; the Darwin Medal of the Royal Society in 1936, and the Agassiz Medal for Oceanography of the National Academy of Sciences in 1936.

AMERICAN LIBRARIES AND FOREIGN PERIODICALS

IT is reported by Harold Lancour, librarian of Cooper Union, chairman of the Engineering School Libraries Section of the Association of College and Reference Libraries, that American librarians are tracking down hundreds of publications which seep into this country from Axis-dominated areas and which contain valuable technical and scientific data eagerly sought by scientific workers.

Through an investigation in progress since last August, the section has already ascertained that more than 800 periodicals published in Germany and Japan as well as in countries occupied by the Axis are reaching the United States sporadically and by devious channels, despite mailing restrictions and accidents in transit.

Many foreign periodicals legally mailed go down with torpedoed ships or are held up to make room for more vital cargo. Others, not permitted to go outside the country which publishes them, are smuggled out by refugees; some pass the censor in limited numbers; still others reach Americans by mail from scientific men in conquered lands which do not permit bulk mailings but which allow individuals to send out one or two periodicals.

Spotty holdings of foreign periodicals by libraries throughout the country, with many issues and titles missing completely since 1939, has created a demand for a master file through which every library will be able to find quickly any issue of any foreign peri-

odical known to be available in some library in the country. By referring to an over-all list showing which libraries are in possession of certain issues of the various periodicals, it will be possible to obtain urgently needed material by borrowing or by photostatic reproduction of the desired material.

Important government research projects, such as the experimental production of a substitute for hemp which is to be undertaken jointly during the coming year by the U. S. Department of Agriculture and Iowa State College, are dependent to a considerable degree upon war issues of foreign journals.

Almost daily calls are received by libraries for issues of foreign periodicals published since the war's beginning on the prevention of disease among human beings and animals, as well as publications shedding light on food and nutrition problems.

Mr. Lancour points out that "we are pledged to secrecy regarding the nature of much of the research work in progress. Research in wartime is accelerated at a rate it would never reach in peace time, and the government is spending money, energy and time to an unprecedented extent on technical and scientific investigations. The importance of intensive research in wartime is amply borne out by Germany, who would be lost without her 'ersatz' products—largely made possible by chemical research."

So important is the preparation and maintenance of a master file of current technical and scientific literature published abroad and obtainable in this country, that the Library of Congress has recently taken over the project begun by the Engineering School Libraries Section, which embraced only technological and engineering publications. The Library of Congress, it is explained, will continue the investigation and broaden the list to include publications devoted to agriculture, medicine and other scientific and technical fields.

Hundreds of libraries throughout the United States are aiding investigators in establishing the whereabouts of missing issues and titles. Each library will report on its own holdings, and make additions to the list of titles circulated to them for checking. The final list, which will also include periodicals available only on microfilm or photostats, will be kept up to date through regular checkup reports by participating libraries. All libraries on the mailing list of the Library of Congress will receive a copy of the up-to-date list at intervals for their own use in filling requests for foreign publications.

THE SCHOOL OF DENTAL AND ORAL SURGERY OF COLUMBIA UNIVERSITY

IN his annual report Dr. Willard C. Rappleye, dean of the School of Medicine of Columbia University, states that the School of Dental and Oral Surgery may continue in the post-war period the accelerated program by which students graduate in three years instead of four, provided that it is possible to give financial assistance, and that necessary adjustments can be made in state laws governing licensure for practice.

He points out that it seems logical that loans and scholarships for these men and women would be a good investment, both from the standpoint of the individual student and the community. The inauguration of the accelerated program presents a very serious problem to students who have been dependent upon funds earned during the summer period. He writes: "We are extremely grateful to the W. K. Kellogg Foundation for a grant of $10,000 for a special scholarship and loan fund for our students. This gift will make possible the completion of the professional education of many of our students who might otherwise have been obliged to abandon their dental course."

An attempt is being made to modify the instruction somewhat to compensate for the decreased efficiency of students working during the summer months. More conferences will be held, and an extensive use will be made of kodachrome microphotographs of the slides of the tissues and organs. The report points out further that

> the war has had a decided effect upon the operation of the Dental School. Nine members of the staff have been granted leave of absence to serve with the Army or Navy. The fact that dental students have been able to apply for reserve commissions as ensigns in the Navy and as second lieutenants in the Medical Administrative Corps of the Army has assisted in reducing the tremendous amount of clerical work previously required in securing deferment of dental students for periods of six months from the local draft boards.
>
> However, the fact that the Army, the Navy and the Marines are competing with each other in advertising for young men to enlist is going to deplete the ranks from which dental students have been drawn and result in a less desirable selection of students for the schools and a wasteful use of the nation's manpower. Of the forty-six male members of the graduating class all but seven are commissioned in the Army or Navy, and twenty-one have been called to active service.
>
> The war has also made itself felt in the increased cost of supplies and equipment for the operation of the school clinic and in the inability to secure many items at any price.
>
> The department of physiology has been devoting much of its investigative work to the study of traumatic shock, under contract with the Office of Scientific Research and Development. Additional support for this and related studies has been received from the Josiah Macy, Jr., Foundation.

In the division of oral histology, Professors Charles F. Bodecker and William Lefkowitz have shown that structural changes occur in the dentin after the eruption of the teeth. These changes have been called "protective metamorphosis" because they offer an added resistance to decay. Dr. Lefkowitz has demonstrated that protective metamorphosis begins in the crowns of the teeth five years after their eruption and progresses to the root. These changes show that vital activity occurs in the dentin long after this tissue is fully formed.

DIVISION FOR EMERGENCY TRAINING AT THE UNIVERSITY OF MICHIGAN

Special training programs for all students preparing for military and civilian service to the country which do not fall within the scope of the fourteen existing schools and colleges of the University of Michigan will be organized and directed by a new Division for Emergency Training, established by the Board of Regents at their December meeting. The division will not take over the functions of the older schools and colleges or attempt to duplicate their work, but will supplement their activities and act in cooperation with them.

The teaching staff will be recruited in so far as possible from the present faculties, many of whose members can be loaned by their respective schools and colleges in view of reduced teaching obligations resulting from the draft of men of college age and the calling up of college reservists. Associate Professor Marvin L. Niehuss, of the Michigan Law School, was named coordinator of emergency training and will act as executive head of the division.

The regents directed the new division to plan and announce training programs relating to the war effort for the following classes of students:

(1) Those high-school graduates who wish to receive special preparation prior to their induction in the armed service.

(2) Those students now enrolled in the university who wish kinds of preparation for special war or supporting civilian service not available in the schools and colleges in which they are enrolled.

(3) Adults, including those who are not high-school graduates, but who are qualified to take courses offered in the division.

(4) Officers and enlisted men and women of the armed forces who may be sent to the university for prescribed training not available in the other schools and colleges.

(5) Veterans of the present war who wish specialized training not provided in the existing schools and colleges.

(6) Such other selected individuals not eligible for admission to other schools and colleges of the university for whom it is possible and expedient to provide programs of instruction that would increase their efficiency in the armed forces or in supporting civilian services.

Establishment of the division is especially important in the light of the newly announced plans of the Army and Navy which contemplate the use of college and university facilities for training officers and specialists for various branches of military service and in view of the demand for specialized training of personnel for jobs in the supporting civilian economy. Training in both these categories may cut across the lines separating the functions of the existing university units and call for a centralizing agency which can mobilize all university facilities in the emergency. The division will be able to admit students for special war training who do not meet entrance requirements in the older teaching units, thus eliminating the necessity of changing these requirements and disrupting the existing instructional programs which are essential for other groups of students.

BEQUEST FOR THE ENDOWMENT OF THE TECHNICAL INSTITUTE OF NORTHWESTERN UNIVERSITY

A bequest of more than \$20,000,000 is made to Northwestern University by the will of Walter P. Murphy, manufacturer of railway supplies, who died on December 16. Dr. Franklyn B. Snyder, president of the university, points out that this is the largest bequest ever made to higher education by a citizen of Chicago, and is probably the largest in the nation since 1924, when James B. Duke bequeathed \$40,000,000 to Trinity College (now Duke University).

Notification of the bequest came to President Snyder from the executors of the Walter P. Murphy estate, who informed him that Northwestern University will receive the entire estate after payment of bequests to relatives and friends and that the value of the gift was estimated to be "in excess of twenty million dollars."

Mr. Murphy specified that the fund should be used to develop, maintain and operate the Technological Institute of Northwestern University, which was founded in 1939 with a gift of \$6,735,000 from the Walter P. Murphy Foundation. Beyond this restriction, no limitation was placed on the use of the bequest, leaving to the board of trustees of the university the final decision as to future management.

Mr. Murphy expressed a desire that as much as possible of the principal should be held intact and used for endowment of the institute. At the same time he empowered the trustees to spend portions of the principal from time to time, and all or any part of the annual income, for additional buildings, equipment, professorships, scholarships, books, research and such other purposes as the trustees think necessary to the proper operation of the institute. He also specified that the institute, as a part of its operations, may give instruction in science to other than engineering students of the university.

The present bequest is Mr. Murphy's fourth benefaction to the university. He made two gifts in 1923, one of $5,000 to the College of Liberal Arts and one of $10,000 to the School of Commerce. In 1939, through the Walter P. Murphy Foundation, he gave $6,735,000 to erect and equip the new building of the institute.

Completed in the fall of 1941 at a cost of $5,000,000, the Lannon stone building was dedicated on June 15 and 16, 1942, with a series of conferences in which educational and industrial leaders of the nation participated. It houses the departments of civil, chemical, mechanical and electrical engineering of the institute, and the departments of physics and chemistry of the university.

The institute is operated on the "work-study" plan in which student engineers alternate three months of study on the campus with equal periods of work in cooperating industries. It began operations in the fall of 1939, before the present building was erected, and to-day has an enrolment of 750 full-time students. Approximately 95 industrial organizations in thirteen states cooperate with the institute in its work-study program.

Built to accommodate about 1,000 engineering students, the institute is to-day training 4,500 men and women to acquire technical skills essential to winning the war. In addition to training engineers, it is carrying on the following vital activities: a Naval Radio Operators' School; an Army Signal Corps Officers' Training School; a pilot training program for the Navy; evening courses to train workers for war industries; and a vast program of confidential war research for the government.

Mr. Murphy has consistently avoided any personal recognition of his generosity in founding the institute, rejecting on several occasions the suggestion that the institute be named after him. In the great halls of engineering and science that he established, there is no mark of recognition of him except one—a portrait that he permitted to be hung in the faculty lounge on the top floor of the north tower.

SCIENTIFIC NOTES AND NEWS

DR. JAMES B. CONANT, president of Harvard University, formerly Sheldon Emery professor of organic chemistry, will receive the annual award of the New York Academy of Public Education for distinguished service to education. The presentation will be made at the annual dinner meeting of the academy, which will be held at the Hotel Waldorf-Astoria on February 18. Dr. Conant will be the speaker at the dinner. His subject will be "The Relation of Science to Society in the Post-War World."

SIR JOHN RUSSELL will retire on September 30, under the age limit, from the directorship of the Rothamsted Experimental Station. Sir John succeeded Sir Daniel Hall in 1912. The station reaches its hundredth year in 1943, and but for the war the centenary would have been the occasion of an international celebration.

IN recognition of his distinguished services as rector of the Imperial College of Science and Technology from 1929 to 1942, Sir Henry T. Tizard, president of Magdalen College, Oxford, has been elected to an Imperial College fellowship.

THE honorary degree of doctor of science was conferred by the Drexel Institute of Technology, Philadelphia, on December 17 on William L. Batt, chairman of the Engineering Industrial Division of the National Research Council, who gave the commencement address at the Founder's Day and commencement exercises of the institute.

AT the fiftieth anniversary commencement of the New Jersey College of Pharmacy in Newark on January 6, Rutgers University conferred the honorary degree of doctor of science on George D. Beal, assistant director of Mellon Institute of Pittsburgh. According to the citation the action was taken "to pay appropriate tribute to Dr. Beal for his contributions to scientific progress in general and to pharmaceutical chemistry in particular."

THE *Journal* of the American Medical Association reports that Dr. John L. Myers, Kansas City, was presented with a wrist watch during the meeting of the American Academy of Ophthalmology and Oto-Laryngology, in appreciation of his sixteen years' service as a section secretary of the academy.

DR. WILLIAM A. PROUT has been appointed acting director of the School of Pharmacy of the Medical College of the State of South Carolina, Charleston. He will continue as professor of pharmacy.

Chemical and Engineering News reports that R. Bowling Barnes, of the Stamford Research Laboratories of the American Cyanamid Company, has been elected first president of the National Conference of Electron Microscopy formed by leading workers in this field meeting at the National Chemical Exposition in November. Albert F. Prebus, of the Ohio State University, was elected vice-president, and Charles Banca, of the RCA Manufacturing Company, Camden, N. J., secretary-treasurer. Dr. V. K. Zworykin, of the Radio Corporation of America, and Dr. O. S. Duffendach, of the University of Michigan, were

elected to serve with the officers of the conference as its directors. Dr. G. L. Clark, of the University of Illinois, presided at the formation meeting. Dr. Clark, L. A. Matheson, Dow Chemical Company, and Dr. Duffendach constituted the committee which called and arranged the initial conference.

DR. JAMES G. HORSFALL, head of the department of botany and plant pathology of the Connecticut Agricultural Experiment Station, a member of the "plant protection committee" of the National Research Council, has been appointed chairman of the "fungicide sub-committee" of the American Phytopathological Society.

DR. ALBERT W. DAVISON, William Weightman Walker professor of chemical engineering and head of the department at the Rensselaer Polytechnic Institute, has been appointed scientific director of the research laboratories at Newark, Ohio, of the Owens-Corning Fiberglas Corporation. He is succeeded at the institute by Dr. Louis S. Coonley, associate professor of chemical engineering.

THE *Journal* of the American Medical Association states that Dr. Bert E. Caldwell, for fifteen years executive secretary of the American Hospital Association, has resigned effective on the appointment of a successor. Dr. Caldwell has been editor, since its establishment seven years ago, of *Hospitals*, the journal of the association.

RICHARD A. MCLEAN, assistant curator of mollusks at the Academy of Natural Sciences of Philadelphia, has been commissioned an ensign in the Navy and is assigned to Fort Schuyler, N. Y.

DR. DONALD FAIRBAIRN has been appointed postdoctorate fellow in biochemistry under a Hoffmann-La Roche grant in the University of Pittsburgh.

HAROLD W. COLES, of the Mellon Institute, has become associated with the research staff of the Bausch & Lomb Optical Company, Rochester, N. Y. He has been placed in charge of the new department of organic chemistry.

DR. ENRIQUE BELTRÁN, professor of zoology at the University of Mexico and head of the Division of Protozoology of the Institute of Public Health and Tropical Diseases, has been invited by the American Government to make a visiting tour to the United States. Professor Beltrán, who is also permanent secretary of the Mexican Society of Natural History, plans to visit various laboratories, museums and learned institutions at Washington, Baltimore, Philadelphia, New York, Chicago, Memphis and New Orleans.

A DINNER meeting of the Midwest Section, American Association of Cereal Chemists, will be held on January 11 at 29 South LaSalle Street, Chicago. At that time Dr. Robert D. Coghill, chief of the fermentation division, Northern Regional Research Laboratory of the U. S. Department of Agriculture, Peoria, Ill., will be the speaker. Dr. Coghill will present the latest authoritative information on fermentation as a tool in the utilization of farm products, based on a recent paper he gave before the American Association for the Advancement of Science. The meeting will be shared by cereal chemists and brewing chemists.

THE Naval Ordnance Laboratory at the Navy Yard, Washington, D. C., is a research and development agency of the Bureau of Ordnance, concerned with the design of new types of naval mines, depth charges, torpedoes, aerial bombs and other ordnance equipment, including measures for the protection of ships against mines. This laboratory is urgently in need of additional technical personnel. Physicists and electrical engineers with electronics experience are required. The laboratory also needs mechanical engineers familiar with the design of small mechanical movements or mechanisms. Several openings are available in technical report writing and editing.

THE New York meeting of the American Physical Society, originally announced for December 28, 29 and 30, will be held on January 22 and 23 at Columbia University. The meeting normally held in February will be omitted. However, a meeting will take place toward the end of April in a city (not Washington) later to be designated.

"THE Role of the Teacher and the Scientist in Civilian Defense" will be the subject of a discussion to be held by the New York branch of the American Association of Scientific Workers on Wednesday, January 13, at 8:15 P.M. Dr. Harry A. Charipper, chairman of the department of biology, Washington Square College of Arts and Science, and member of the Central Training Staff, Air Warden Service, Police Department, New York City, will be the main speaker. Three British civilian defense films will be shown, describing the detection and identification of poison gases, the incendiary bombing of London and the Air Raid Precaution Services of London and Moscow. The meeting will be held in Room 703, Main Building, Washington Square College of Arts and Science, 100 Washington Square East, New York City.

THE Arnold Arboretum of Harvard University has recently received a gift of $50,000 from Miss Louisa W. Case, of Weston, Mass., together with her residence, barns, greenhouses and fifty-nine acres of land in Weston, to be utilized for the general purposes of the arboretum. The real estate is assessed at $84,000. The gift is a memorial to James B. Case, the father of Miss Case. Several hundred young hybrid oriental

crab apples and cherries have already been planted by the arboretum staff on the Case estate.

THE Army-Navy "E" Award was presented on December 29 by Major General Benjamin W. Chidlaw, assistant chief of staff of the Engineering and Material Division of the U. S. Army Air Forces, to the Nylon Research Laboratory and Pilot Plant of the du Pont Company. The award of lapel pins to employees was made by Captain C. A. Bonvillian, U.S.N., of the Industrial Department, Philadelphia Navy Yard. This will be the sixteenth official presentation among seventeen "E" awards which have been made to plants of E. I. du Pont de Nemours and Company.

THE council of the British National Farmers' Union has decided to ask the Ministry of Agriculture to send a representative to the United States, New Zealand, and any other countries where drying of foodstuffs is being carried out on a commercial scale in order to secure full information regarding processes of dehydration.

The Times, London, states that plans for the world after the war were discused at two meetings in London on November 20. Allied physicians of the nations who spoke on medical aid to stricken Europe agreed that steps would have to be taken by instruction and propaganda, possibly through broadcasting, to restore suitable standards of nutrition and to prevent an increase in infection in the occupied territories. The physicians who work as a technical advisory committee under the Allied Post-war Requirements Bureau have also agreed upon a basic list of drugs which will be needed in the occupied territories as they are liberated. At the second meeting representatives of allied departments met at the Board of Trade to discuss questions relating to the post-war economic structure. Mr. Harcourt Johnstone, parliamentary secretary to the Department of Overseas Trade, presided.

DISCUSSION

FIGMENTS OF THE IMAGINATION

MOST residents of the United States who have not had tropical experience look on the tropics with dread because of the "snake-infested jungles." This idea has been built up over a long period of time by highly imaginative travellers who apparently feel that they must impress their audiences with the great dangers they encountered and overcame in their arduous explorations of these terrible regions; the curious thing is that they always live to tell their harrowing experiences with these deadly reptiles. They are always encouraged to expand on the subject by the enterprising newspaper reporter and popular writers who must make a story. The result is that the average individual, visiting the tropics for the first time, expects to see poisonous reptiles behind every tree and bush and even hanging from the branches ready to do their deadly work. These traveller's tales, told over and over again, and losing nothing in the telling, have resulted in establishing an ingrained fear of the tropics on the part of our general public, and this in turn proves to be distinct dis-service to the thousands of our soldiers and marines who, of necessity, must now serve in one part of the tropics or another.

As a matter of fact in no part of the Old World tropics with which I am personally familiar are poisonous snakes either common or numerous, and I speak on the basis of twenty-two years actual experience. Much of this time was spent in the forests and jungles in all parts of the Philippines, with some experience in the Malay Peninsula, Java, and Borneo. On many trips lasting from two to six weeks each, on some of them being constantly in the forests and jungles, and seeing no other persons than the members of my own party, I have never actually seen a single snake, poisonous or otherwise; on other trips one might average seeing perhaps one snake in a week. The snakes are there, but if one is interested in snakes one must know where, how, and when to look for them. They are mostly timid and disappear at the slightest disturbance. Interested in checking on my own personal experiences I asked Dr. Frans Verdoorn, who spent two years prosecuting intensive field work in botany in the Malay Peninsula, Sumatra and Java, and he reports that he almost never saw a snake in the jungle. I asked Colonel Arthur S. Fisher, who was evacuated from Corregidor shortly before that fortress fell to the Japanese, and who for three months was in active service on Bataan Peninsula after the fall of Manila, and he stated that he saw exactly four snakes in three months, and two of these were brought to him by soldiers. My personal experiences in the American tropics are limited to six trips to Cuba; and I never saw a snake in Cuba. Professor Oakes Ames informs me that in his trips to parts of Mexico, Yucatan, Panama, Honduras, Costa Rica, Colombia, Venezuela, Ecuador, and Brazil, he saw a total of three snakes.

As a matter of fact there is infinitely less chance of an individual operating in the tropical forests and jungles being bitten by a poisonous snake than there is in any part of the United States where the water moccasin and the rattlesnake occur. On any pleasant

day in summer, on a day's trip through the fields and woods, even in New England, one will actually see many more snakes than one would encounter in any part of the tropics with which I am familiar, if one excepts the seasonal sea snakes. These reptiles, at certain seasons, may at times be seen literally by the thousands, particularly when they leave the sea to breed. All or most of them are poisonous, but their mouth parts are so constructed that they can not possibly strike a flat surface (they might be able to strike a small surface like one's finger). It is rather amusing to note how indifferent the native fishermen are when they happen to draw a net and bring in large numbers of them; they kick them about with their bare feet and nonchalantly pick them up and throw them back into the sea—so much for poisonous snakes.

Another fetish is the terrible poisonous plants that one must guard against in the tropics. I suppose that here our imaginations have been fed by the marvellous tales of the deadly upas tree, and in modern times, by the terrible man-eating tree of Madagascar. Incidentally some years ago, an American soldier who couldn't let the Philippines be outdone by Madagascar, published a lurid Sunday supplement story about one he saw in the Philippines; just another case of *horribilia philippinensia*. Here again, as far as contact poisons are concerned, there is infinitely less chance of one's being poisoned in any part of the Old World tropics than there is in any part of the United States where the poison ivy, poison oak, and poison sumac occur. In the jungles of the Malay Peninsula, Borneo, New Guinea, or any other part of the Malayan region, one is infinitely safer, as far as dangerous plant species are concerned, than one would be in the suburbs of Boston or in the Berkeley hills in California, or even within the New York Botanical Garden or the Arnold Arboretum where poison ivy occurs. It is interesting to note that without exception, and no matter where they occur, those plant species that produce eruptions simulating *Rhus* poisoning, all belong in several genera of the same natural family, the Anacardiaceae. Thus in the Malay Peninsula, Sumatra, Java, and Borneo, there are various forest trees collectively known as *rengas*, belonging in such genera as *Gluta, Melanorrhoea, Melanochyla, Semecarpus,* and *Swintonia,* that have a distinctly poisonous sap; some of these genera have representatives in the Philippines and in New Guinea. The sap of several species of *Mangifera,* such as *M. caesia* (bingai), *M. odorata* (kwini), *M. kemanga* (kemang), *M. foetida* (bachang), cause bad skin eruptions; rarely one will note cases where individuals may be allergic to the common mango (*Mangifera indica*). Several of these "poisonous" species of *Mangifera* are actually cultivated for their edible fruits and occur about residences and in towns, but the local residents are not inconvenienced by them. Even the resinous sap in the pericarp of the fruit of the common cashew nut (*Anacardium*) is irritating. The remedy for any eruptions caused by contact with the sap of these species is the same as that indicated for poison ivy infections. In passing, it is interesting to note that while the sap of the trunk or branches, or occasionally the leaves may be irritating, yet in several of the genera mentioned above the fruits may be eaten with impunity (*Mangifera, Semecarpus,* and some species of *Gluta*).

Aside from the contact poisons among the representatives of the Anacardiaceae mentioned above, mostly large forest trees, and not likely to cause any trouble except if one actually cuts them down, all other plants with which one might come in contact in Malaysia and in Polynesia may be classed as minor nuisances. These are the few species that bear stinging hairs. The worst of these are the tree nettles (*Laportea*) of which about 100 species have been described. Contact with the hair-bearing parts instantly produces the sensation of having touched a piece of very hot iron. While the sting from these hairs (apparently caused by formic acid) is intense, it is not normally dangerous, for not even a cub Boy Scout would touch a plant a second time. Fortunately these shrubs or small trees are not common, and certainly none of them is to be feared. *Laportea* is merely a somewhat exaggerated stinging nettle.

The remaining category are those species, few in number, widely scattered, and often very rare, where the inflorescences, or the fruits, or both, may be supplied with stiff bristle-like stinging hairs, their tips supplied with minute retrorse barbs (*Mucuna*). These hairs are easily detached but are never poisonous, and are merely mechanical irritants. They are never dangerous, and again not even a cub Boy Scout, once stung, would touch a plant a second time. And we should remember that cowhage (*Mucuna*) hairs were formerly used as a remedy for tapeworm, the hairs being mixed with molasses and swallowed. The theory back of this remedy, I suppose, was that the tissues of the tapeworm are softer than the lining of the human stomach and would thus attract the stinging hairs which in turn would kill the tapeworm.

E. D. MERRILL

MORE ABOUT "DEFORMATION OF ROCK STRATA BY EXPLOSIONS"

MR. NETTLETON[1] is probably correct in rejecting the idea that the gravity anomaly found in Sierra Madera

[1] L. L. Nettleton, SCIENCE, December 4, 1942, Vol. 96, No. 2501, page 515; J. D. Boon and C. C. Albritton, Jr., SCIENCE, October 30, 1942, Vol. 96, No. 2496, pages 402–403.

is due to buried meteoritic material. Not that meteorites large enough to produce this anomaly never fall upon the earth, but rather that giant meteorites are largely back-fired from their craters. Moulton[2] has calculated that a swiftly moving meteorite may produce a pressure of fifteen million atmospheres at the time of its impact. No one knows how earth rocks would be affected by fifteen million atmospheres of pressure, for this is far beyond our experiments and in fact beyond our comprehension. However, it seems quite certain that rocks of all kinds would be greatly compressed by this amount of pressure. If this be true a terrific explosive rebound must follow the impact, lifting strata far above their original level. This uplift of the deeper strata might well produce a gravitational anomaly. Rebounds of elastic solids is not a matter of speculation. It seems to be characteristic of all great impacts that are not able to break through the material that receives the impact.

Can any one suggest how structural bilateral symmetry with overtilted beds on one side of the structure can be produced by volcanic explosions that come solely from within the earth? It is this kind of symmetry that is found in Meteor Crater, Sierra Madera, Flynn Creek structure and a number of the cryptovolcanic structures. Oblique meteorite impacts offer a satisfactory explanation of this symmetry.

J. D. BOON[3]

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VITAMIN C (ASCORBIC ACID) CONTENT OF THE BUFFALO-BERRY

THE buffalo-berry, *Lepargyrea argentea* (Nutt.) Greene, a native fruit of North Dakota, has been found to contain an abundance of vitamin C, as determined by the method of Bessey and King,[1] as adapted for the Evelyn photoelectric colorimeter by Bessey[2] and Morell.[3] The ripe fruit, on a fresh basis, apparently contains well over 150 mgs of vitamin C per 100 grams. One sample of fruit, picked on October 15, 1942, contained 184 mgs of vitamin C per 100 grams.

This fruit is usually consumed in the form of a jam or a jelly. Although destruction of vitamin C occurs, samples of buffalo-berry jam contained 80 to 90 mgs of vitamin C per 100 gms.

DARLINE KNOWLES
IMMANUEL WILK

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SCIENTIFIC BOOKS

VITAMINS

Chemistry and Physiology of the Vitamins. By H. R. ROSENBERG. xix + 674 pages. New York: Interscience Publishers, Inc. 1942. $12.00.

THIS is an encyclopedic monograph treating practically all the substances commonly called vitamins; and, in general, each of them on the same comprehensive plan—nomenclature, chronology, occurrence, isolation, properties, specificity, synthesis, industrial methods of preparation, determination, "standards" (units of quantitative expression), metabolism and requirements in nutrition. Different aspects are, however, obviously treated with very different degrees of fullness; and, in the opinion of this reviewer, of critical acumen as well. In his preface the author introduces himself as having "been connected, at some time or other, with the development of many of the vitamins known to-day"; and this phrase well foreshadows the strength and weakness of the author's handling of the broad and many-sided subject he has undertaken. The book gives a relatively complete account of the "development" of each vitamin from a biochemical discovery into a commodity to be patented, if possible, and manufactured for commerce; while the treatment of the significance of the vitamins in nature, and in the scientific undertaking "to render more intelligible the world in which we live," is disappointingly sketchy; and the generalizations as to vitamin values of foods are unwarrantably dogmatic in form and, at least in this reviewer's opinion, excessively pessimistic in substance.

The volume contains the materials for a useful reference handbook on the industrial chemistry of the vitamins. It seems unfortunate that in so many of the chapters this useful material is intermingled with compilations of material from the physiological or nutritional literature of the vitamins which latter can hardly be said to be handled with a firm grasp nor with freedom from errors and inconsistencies, *e.g.*, on pages 34; 57 and 60 *vs.* 75; 100; 123; 180; 190; 198; 199; 338. Whether all these will be obvious to the reader will naturally depend largely upon the knowledge of vitamins which he already

3 In the absence of the junior author, C. C. Albritton, Jr., the senior author should be held responsible for this reply.

1 O. A. Bessey and C. G. King, *Jour. Biol. Chem.*, 103: 687, 1933.

2 O. A. Bessey, *Jour. Biol. Chem.*, 126: 773, 1938.

3 S. A. Morell, *Indust. and Eng. Chem., Anal. Ed.*, 13: 793, 1941.

possesses. Any that are not obvious are, of course, the more unfortunate on that account.

Although they were published early in 1941, the "Recommended Allowances" of the National Research Council's Committee on Food and Nutrition (now Food and Nutrition Board) do not appear in Dr. Rosenberg's sections on "requirements." This omission not only impairs the value of these sections but illustrates further the unevenness of the book.

On the other hand, the sufficiently advanced and critical reader may find this book useful for its conveniently summarized chronologies, its many footnote references to original sources, its comprehensive compilations of the series of synthetic steps leading to industrial production of individual vitamins, and its extended listing of patents.

H. C. SHERMAN

ORGANIC CHEMICAL EXPERIMENTATION

Semimicro and Macro Organic Chemistry. By NICHOLAS D. CHERONIS. 388 pp., 63 illustrations, 12 tables, 40 pages of questions, 15 report forms. Thomas Y. Crowell Company. 1942. $2.75.

THIS laboratory manual, containing semimicro and macro methods of 70 organic preparations, constitutes the first systematic and practical application of semimicro methods of experimentation to general organic preparative methods. The author, beyond any doubt, demonstrated "that it is possible to attain all the objectives of laboratory practice in elementary organic chemistry, using the semimicro technic. In addition, this method offers the following advantages over the traditional method: (1) it permits better adaptation of the laboratory work to the varying needs of the students; (2) it teaches students greater care, cleanliness and manipulation; (3) it is more economical; and (4) it reduces substantially the seriousness of possible accidents since the quantities of reagents and size of equipment are only some 10 to 20 per cent. as great as with macro methods." The author also appears to have made the substantially correct observation that over-all application of the classical organic micro preparative methods of Behrens and Kley, Emich, and others, appear as yet not practical enough for general organic preparative laboratory practice and that for this purpose semimicro methods constitute the ideal solution, thus substantiating similar observations made by the reviewer in the teaching of qualitative organic analysis.

This laboratory manual, although still retaining one macro method for each procedure, must be heralded as a landmark in the field of organic chemical experimentation which may be expected to lead eventually to a complete replacement in the teaching of macro methods used heretofore in this field, thus paralleling the successes of semimicro methods in qualitative inorganic and of the micro methods in quantitative organic analysis.

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AMATEUR SCIENCE

The Amateur Scientist: Science as a Hobby. By W. STEPHEN THOMAS. Pp. 291. New York: W. W. Norton and Company, Inc. 1942. $3.00.

As long ago as 1890 the writer and another boy in second-year high school arranged with a devoted teacher, who didn't consider her day's work over at four P.M., to remain after school and assist them in some simple chemical experiments in which they had become interested. They had never studied "high school chemistry." A very few years later, one of these boys continued his chemical studies by taking evening courses in the Massachusetts Institute of Technology. Eventually he became chief metallurgist in one of the laboratories of the General Electric Company. Probably few of the staff of university-trained chemists and metallurgists who served under him realized that he owed his position chiefly to the encouragement of a boy's spontaneous amateur interest in chemistry.

Doubtless instances similar to the above could be multiplied many times. One can never forget that the electrical process of making aluminum was discovered by a young man twenty-two years old, Charles M. Hall, whose boyish scientific interests were encouraged. For the advancement of science it is a fundamental thing to stimulate and encourage an interest in any aspect of science wherever it manifests itself, and especially in young people.

Dr. Frederick P. Keppel, while president of the Carnegie Corporation of New York, instituted an inquiry into methods of promoting an interest in science among amateurs, and a committee on organization, with Dr. Edwin G. Conklin as chairman, made a survey of the Philadelphia region. One result of Dr. Keppel's work was that the American Philosophical Society, at Philadelphia, cooperating from the beginning, appointed a Committee on Education and Participation in Science, with Dr. Conklin as chairman. This committee organized an executive staff with W. Stephen Thomas as executive secretary, on a full-time basis, beginning on June 1, 1939. This committee began to issue a series of bulletins on "Activities in Science in the Philadelphia Area." The bulletin for February 1, 1942, contained the disappointing notice that the work of the Committee on Education and Participation in Science had to be discontinued because Mr. Thomas had entered the Army.

Fortunately, however, before he terminated his work with the Philosophical Society, Mr. Thomas had prepared for publication a book of 291 pages, "The

Amateur Scientist: Science as a Hobby." The foreword is by Dr. Conklin. A certain number of copies have been distributed to various educational and scientific institutions by the Carnegie Corporation. The eight chapters of the book deal with Science and Ourselves, Science as a Hobby, Who is the Amateur Scientist?, The Amateur Scientist and the Community, Organizations of Amateur Scientists, Research and the Amateur Scientist, Sample Programs for Amateur Research, The Amateur Scientist and the Future.

The book sets forth the aims, methods and results, of a two and one-half years survey of amateur science in the Philadelphia region and the broader conclusions to be drawn from it—especially the great importance of encouraging people to be "scientifically-minded" when confronted with social, political and international problems, as well as with the problems of science. "Plainly," says the author, "the scientist is either indifferent to his relationship to the public or else he shies away from interpreting his findings to the layman for fear of being misunderstood."

The first chapter sets forth briefly how our daily lives are affected by modern science and notes how wide-spread is the amateur interest as indicated by studies made by the American Association of Adult Education. The second chapter discusses why laymen so often adopt one of the sciences as a recreational pursuit. The educational importance is stressed of having a program of public education that equips one not only for a vocation, but to spend his spare time with profit and interest—to live as well as to make a living.

One who might be inclined to question the value to science of encouraging the interest of amateurs, says the author, need only be reminded that Isaac Newton was a public official, Leewenhoek a Dutch merchant, Benjamin Franklin a printer, Sir William Herschel an organist, Priestley a preacher, Darwin a country gentleman, Mendel a monk, Fabre a village school teacher (p. 40). The situation in Philadelphia and vicinity is presented as a sample of what has been and is being done, but the book has a broad outlook and range, and is full of helpful suggestions for promoting and organizing the layman's interest in science. The Philadelphia program is worthy of careful study and imitation (with variations of course as to detail, etc.), and the book is to be commended to the careful attention of every one who is interested, not only in science, but in public education and public welfare.

C. STUART GAGER

BROOKLYN BOTANIC GARDEN

REPORTS

AUSTRALIAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH[1]

THE fifteenth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia, covers the year ended June 30, 1941, and includes the financial statement as well as lists of publications of the council and of the personnel of the council and its committees and the committees concerning work in which the council is cooperating.

A large part of the council's activities is now devoted to the solution of problems arising out of the war, and to assistance and advice to various government departments and other institutions and organizations which are concerned with that effort. This applies particularly to the National Standards Laboratory, the Aeronautical Research Laboratory, the Forest Products Laboratory and the Division of Industrial Chemistry. The reference to these activities is limited to brief general statements or omitted entirely.

Plant investigations have been concerned with native or naturalized plants as alternative sources of fiber, particularly as a substitute for jute, and investigations aimed at ascertaining the difference between the fiber from various Linum (flax) strains of good type or being continued. A survey is in progress to ascertain the position with regard to domestic supplies of vegetable and farm crop seed and methods of maintaining them. Weed investigations have shown that the St. John's wort can be virtually eliminated wherever subterranean clover can be grown successfully, but spraying with chemicals has failed to control an infestation of blackberry, and the work on both nutgrass (*Cyperus rotundus*) and mintweed (*Salvia reflexa*) has indicated that chemical sprays are of no value in controlling either plant. Field experiments on the control of take-all and the root-rot of wheat have continued at three sub-stations.

The work on the chemistry of tobacco at the University of Sydney was discontinued, as well as the study of disease resistance by the section of genetics. Work on the yellow dwarf disease, however, has continued actively, as well as investigations on smoking quality and physiological investigations. Fruit investigations have included an extension of the experiments on wax coatings for apples, and a reorganization to coordinate the wider attack on this problem organized by the division of food preservation. A re-examination and summary of the results of the work carried out in Tasmania on the brown-heart

[1] From *Nature*.

problem during the last five years has been made. Extended cooperation with the Tasmanian Department of Agriculture in experiments, particularly in relation to the effect of different stocks and pruning technique on the keeping quality of apples, has also been a feature of the season.

Other investigations have been concerned with storage disorders and with fruit physiology in relation to keeping quality and seasonal climate. Work on pre-storage treatments to increase the cool- and common-storage capacity has now been greatly expanded. A survey is also in progress in coastal Queensland areas to locate indigenous or naturalized plants, which may be sources of certain drugs such as caffeine, ephedrine, cocaine, quinine substitutes and substances such as derris. Attention has also been given to potato virus diseases, particularly to virus X, and trials have been made on fungicidal dusts for the treatment of maize seed. The dusts had no perceptible effect on germination or vigor of early growth, except at Canberra, and then only when inferior or diseased seed was used.

Laboratory work of the division of economic entomology on weevil control has been concentrated chiefly on a study of mineral dusts, and gratifying results have been obtained with one or two effective non-silicious dusts readily available in Australia. Milling tests with treated wheat indicated that the dust is removed in the ordinary mill treating process, although the dust treatment has certain disadvantages such as its effect on the appearance and free-running properties of the grain. Although the division does not possess the special equipment required for accurate assessment of the relative toxicity of fumigants, a series of experiments with simple apparatus has been carried out to determine the susceptibility to fumigants of Calandra and *Rhizopertha dominica* to such fumigants as di-β-chloroethyl ether, chloropicrin, ethyl formate, *o*-dichlorobenzene, carbon disulfide, ethylene dichloride and carbon tetrachloride. Results indicate that Rhizopertha is more susceptible to all these fumigants than either of the Calandra species. Practical fumigation tests of infested wheat in concrete silos have been carried out with ethyl bromide and with Cyanogas G, the latter appearing to give almost complete control of *Rhizopertha dominica*. The sterilization of stack sites and sheds with petroleum oil and tar oil emulsions indicates that only those emulsions containing *o*-dichlorobenzene and di-β-chloroethyl ether or their mixtures with creosote and oil have given consistently good results for killing the developmental stages of *C. granaria, C. oryzae* and *R. dominica,* and good results have been obtained with emulsions of carbon disulfide or *o*-dichlorobenzene with crude naphthalene in the treatment of wheat shed floors when these are of loose earth in which infested grain may be buried.

In investigations on sheep blowfly, considerable progress has been made in compounding two useful dressings, the study of repellants and in an investigation of the breeding-ground of *Lucilia cuprina,* which is responsible for 90 per cent. or more of strikes in Canberra. Toxicity studies using the contact toxicity technique indicate that 0.4 per cent. of arsenious oxide is completely non-toxic to prepupae when immersed for 30 minutes at 23° C., and αα-dipyrridyl is almost as high in toxicity as nicotine, dinitro-*o*-cyclohexyl-phenol and proflavine being only slightly toxic. Other entomological investigations have been concerned with the eradication of cattle ticks, insecticides for the control of wheat weevil and on the oriental peach moth. Animal health and nutrition investigations have covered pleuro-pneumonia of cattle, mastitis in dairy cattle, studies on phenothiazine as an anthelmintic and blowfly problems and coast disease of sheep.

The division of forest products investigation has extended its work in the field of defense, including the examination of numerous specifications for all kinds of defense and munition needs, the submission of advice on substitutes when necessary, and recommendations in regard to modified manufacturing methods or procedures; its work is claimed to have resulted in savings in imports, in the amount of timber used and in the use of timber of lower quality. Flax investigations have been enlarged and both chemical and engineering research in this field are now centered in the division. The promising work on chemical retting is being revived and problems of scutching, tow treatment, drying of retted straw and control of dew retting are also being studied.

Food preservation investigations have covered problems in the preparation and transport of boneless frozen meat, chiefly for the use of fighting services overseas, canning problems, the use of *o*-phenyl-phenol in fillers to restrict bacterial waste in stored eggs, the storage of whole egg powder, the handling, treatment and storage of fruit, etc., investigations which will in future be coordinated by a special committee representing all bodies carrying out work in this field. Protective skin coatings for fruit have been investigated, particularly the preparation of colloidal wax emulsions that leave clear bright films on drying. Chemical treatments for the control of mold wastage in stored grains have also been investigated. Fisheries investigations have covered smoking of fish, fish liver oil production and investigations on Australian tunas, pilchards, mullets, etc.

Brief reference is made to the work of the National Standards Laboratory, to aeronautical investigations

at the aeronautical laboratory, which has now been given the status of a division, and to investigations in industrial chemistry, including that on unshrinkable wool, on wool wax, utilization of minerals and on producer gas investigations, particularly the suitability of Australian hardwoods for the production of charcoal. Substantial progress has been made in building up a research organization and the development of research methods for dealing with lubrication, bearing and wear problems in Australia. The work is undertaken as cooperative research with the University of Melbourne and housed in the new chemistry school. The work of the Dairy Research Section has included a survey of the properties of Australian butter and the storage and transport of butter fat without refrigeration.

SPECIAL ARTICLES

SUBCLINICAL VITAMIN DEFICIENCY[1]

I. TISSUE ANALYSES

INDIVIDUALS subsisting upon inadequate diets generally experience a more or less prolonged period of ill-health before unequivocal symptoms of deficiency make their appearance. Recognition of their deficiency in this subclinical stage is difficult because of the vagueness and generality of their complaints. Speculation on the extent to which the general population may be affected has led therefore to a program designed to decrease the incidence of latent deficiency by increasing considerably the consumption of vitamins.

Definition of "normal vitamin requirements" has proved, however, to be a complicated problem. The suggestion that our civilized diet is not normal has made impossible the customary identification of "usual" with "normal." The essentially intracellular character of the enzymes derived from vitamins,[2] and the poorly understood equilibria between these enzymes and the body fluids, have made difficult the interpretation of vitamin analyses of blood, urine and stools. Before these indirect measurements of nutritional status can be used critically, a primary knowledge of the tissue concentrations which they reflect must be obtained.

The type of information required can be illustrated by Fig. 1. A classical curve of enzyme action is used to represent the probable relationship between tissue thiamin concentrations and the tissue functions dependent upon thiamin enzymes. The problem is to identify the position of points M, m and S, and to determine the thiamin intake necessary to maintain the concentration of enzyme at or near M under varying conditions of energy output, environmental temperature and metabolic mixture. Solution is complicated by the existence of different relationships in different tissues and in different age groups, Tables I and II.

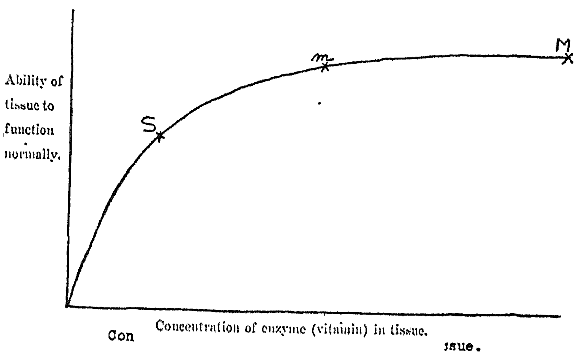

FIG. 1. Scheme of the relationship between tissue thiamin concentrations and the ability of tissues to carry on their normal functions. M = Maximum concentration of enzyme obtainable in tissues. m = Minimum concentration of enzyme compatible with normal function. S = Concentration of enzyme at which symptoms of deficiency appear.

TABLE I

SKELETAL MUSCLE THIAMIN IN DIFFERENT AGE GROUPS OF PRESUMABLY SIMILAR NUTRITIONAL STATUS

Age	Micrograms of thiamin per gram of muscle
6 month fetus	1.4
8 month fetus	1.5
Term infant	1.3
1 year	1.6
5 years	1.0
10 years	1.2
30 years	0.4
37 years	0.4
48 years	0.5
51 years	0.4

Tissues from both post-mortem and biopsy tables are available for vitamin assays. Post-mortem material permits analysis of the relationships between changes in vitamin concentrations in different tissues. Its assay is therefore a necessary preliminary to the evaluation of observations made on single tissues. Biopsy specimens are usually restricted to one tissue but are free from the unspecific effects of terminal illness and have the advantage of permitting repeated observations on ambulatory subjects. From studies of biopsy and post-mortem material a fair composite picture of the relationship between changes in vitamin

[1] Aided by grants from the R. R. Williams and R. E. Waterman Fund for the Investigation of Nutritional Disease, Research Corporation, New York City. Part II—"Micro Muscle Biopsies" and Part III—"The Thiamin Content of Micro Muscle Biopsies" were aided by a grant from the National Research Council, Washington, D. C.

[2] E. A. Evans, Jr., "The Biological Action of the Vitamins." The University of Chicago Press, Chicago, 1942.

TABLE II

CEREBRAL CORTEX THIAMIN IN DIFFERENT AGE GROUPS OF PRESUMABLY SIMILAR NUTRITIONAL STATUS

Age	Micrograms of thiamin per gram of cortical tissue
8 month fetus	0.5
Term infant	0.3
6 weeks	0.6
7 weeks	0.6
6 years	1.3
6 years	1.0
30 years	1.1
51 years	1.0
58 years	1.1

intake and changes in tissue vitamin concentrations may be constructed.

Preliminary work of this kind[3,4] has indicated that the thiamin content of skeletal muscle may serve in man as an index of thiamin nutrition. Changes in muscle thiamin in general parallel changes in other tissues, Table III. Since muscle is readily available

TABLE III

CONCENTRATION OF THIAMIN IN HUMAN TISSUE (MICROGRAMS PER GRAM) PARALLELISM BETWEEN CONCENTRATION IN SKELETAL MUSCLE AND CONCENTRATIONS IN OTHER TISSUES

Patient	Nutritional status	Heart	Liver	Kidney	Brain	Skeletal muscle
A	Good	2.3	1.1	1.7	1.0	0.4
B	Fair	1.3	1.0	1.2	..	0.2
C	Poor	0.6	0.3	0.4	0.5	0.0
D	Alcoholic Polyneuritis	Generalized symptoms: heart failure, jaundice, neuritis				0.2
E	Alcoholic Polyneuritis	Generalized symptoms				0.2
E	2 days after cessation of vitamin therapy	No symptoms				0.6

for biopsy, techniques can be developed which make repeated muscle analyses clinically feasible.[5,6] These techniques should facilitate solution of the general problem posed in Fig. 1 and furnish information concerning the frequency and severity of subclinical thiamin deficiency among the general population. Their extension to other vitamins is being investigated.

II. MICRO MUSCLE BIOPSIES

Investigation of a number of clinical problems—nutritional, metabolic and dystrophic—can be facilitated by a ready supply of skeletal muscle. The needle arrangements described by Silverman[7] can be used for muscle biopsies. For this purpose, the bevel of both the inner and the outer needle should be increased somewhat and the edges of the outer brought to a razor sharpness by honing on a hand stone.

Samples of muscle by this technique run between 5 and 15 mg, wet weight. Several specimens may be obtained through a single novocainized skin puncture. The reliability of the sampling can be verified by micro nitrogen and micro phosphate determinations. The biopsy is not unduly traumatizing and patients readily consent to its repetition. Biopsies of the gluteus maximus appear to be less painful than those made elsewhere.

III. THE THIAMIN CONTENT OF MICRO MUSCLE BIOPSIES

The yeast fermentation method devised by Schultz, Atkin and Frey[8] is admirably suited to the determination of thiamin in skeletal muscle. Pyrimidine blanks in this tissue are small, consistent, probably in fact negligible. The micro method[9] is readily converted to a lower range, Fig. 2, by utilizing standard 15

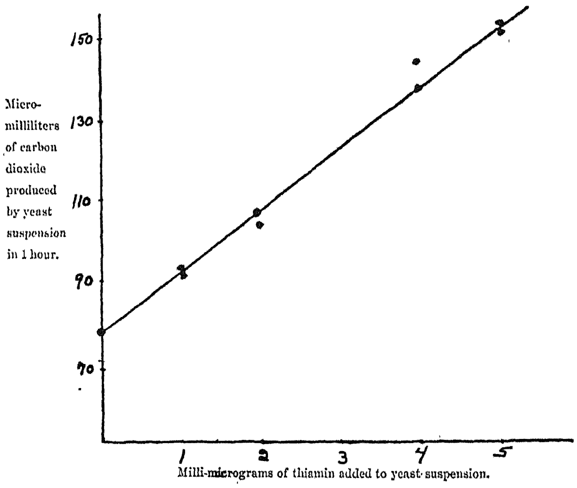

FIG. 2. Effect of thiamin, in 1 to 5 milli-microgram range, on carbon dioxide production of yeast suspension. (15 milliliter Warburg flask, 1 milliliter of nutrient medium, 1 milligram of yeast and 1 milliliter of thiamin standard.)

milliliter flasks fitted with a side-arm gas vent. This modification is sufficient to permit determination of thiamin in micro muscle biopsies secured with the Silverman needle.

Five to 15 mgs of muscle are transferred from the inner split needle to a small weighed tube. The muscle is ground, suspended in 0.02 M acetate buffer, (pH 4.8), and extracted. One milliliter of extract-suspension is pipetted into a 15 milliliter Warburg flask containing 1 mg of yeast in 1 milliliter of

[3] J. W. Ferrebee, N. Weissman, D. Parker and P. S. Owen, *Jour. Clin. Invest.*, 21: 401, July, 1942.

[4] J. W. Ferrebee, N. Weissman, D. Parker and P. S. Owen, "The Thiamin Content of Human Tissue." Association for Research in Nervous and Mental Disease, New York City, December 19, 1941. In press.

[5] This article: II. Micro Muscle Biopsies.

[6] This article: III. The Thiamin Content of Micro Muscle Biopsies.

[7] I. Silverman, *Am. Jour. Surg.*, 40: 671, 1938.

[8] A. S. Schultz, L. Atkin and C. N. Frey, *Jour. Indust. and Eng. Chem.*, (*Anal. ed.*), 14: 35, 1942.

[9] L. Atkin, A. S. Schultz and C. N. Frey, *Jour. Biol. Chem.*, 129: 471, 1939.

medium. The subsequent determination is carried out as described by Atkin, Schultz and Frey.[9]

Micro analyses[9] and analyses by this technique are in good agreement, Table IV. Novocain and adrenalin

TABLE IV

COMPARISON OF MICRO (8) AND SUBMICRO TECHNIQUES OF THIAMIN ANALYSIS. THIAMIN EXPRESSED AS MICROGRAMS PER GRAM TISSUE*

Cat	Date	Condition	Muscle thiamin	
			Micro analysis	Submicro analysis
Old white number 1	5/15	Normal Heart 1.8, liver 2.3, kidney 2.2, Brain 1.4	0.4 0.4 0.4	..
Old gray number 2	6/22	Normal	..	0.5 0.5
Old gray number 2	7/31	3 weeks semi-starvation, moderately deficient diet. Heart 1.0, liver 2.0, kidney 1.7, Brain 1.2	0.3 0.3	0.4 0.4 0.3
Young black number 3	6/23	Normal	..	0.7 0.7 0.8
Young black number 3	7/13	2 weeks semi-starvation, moderately deficient diet	0.3 0.3 0.3 0.3	0.3 0.4 0.3 0.3 0.3 0.3
Young black number 3	7/23	$3\frac{1}{2}$ weeks semi-starvation, moderately deficient diet	0.22 0.23 0.22 0.23	0.27 0.27 0.25 0.26 0.25 0.26
Young black number 3	7/27	2 days after subcutaneous injection of 2 mg. of thiamin	0.96 0.99 1.08 1.08	1.20 1.15 1.20 1.10 1.18

* For micro analyses 1 to 2 grams of skeletal muscle were removed surgically under nembutal anesthesia; for submicro analyses 5 to 15 milligrams of muscle were removed with the Silverman needle.

used in skin anesthesia do not interfere with measurements by the yeast fermentation method. When the muscle is abnormal, aliquots of suspension may be used for micro nitrogen or phosphorus determinations[10] and the thiamin concentration expressed in micrograms per milligram of muscle nitrogen or phosphorus.

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VARIABILITY IN THE PAIN THRESHOLD

HARDY, Wolff, Goodell and Schumacher have reported an unusual series of observations on the absolute pain threshold in man. Using radiant heat as a stimulus, they found only slight variability in pain thresholds, either for repeated measurements made upon the same person,[1] or for measurements made upon different subjects.[2] Furthermore, this threshold pain was said to be so uniform in quality that it was easily recognized even by untrained subjects. These authors attribute the commonly observed differences in pain sensitivity to conditions governing "reaction" to pain, rather than to fundamental differences in perceptual sensitivity as such.

In order to test the generality of the conclusion that pain thresholds are uniform, the writer has used electric current in a series of pain threshold measurements made upon 15 college women. An electronic device of the type recently described by Fender[3] supplied the current. This instrument produces condenser discharges which are amplified and delivered through resistance of such high order that variations in the subject's skin resistance have little effect upon the current flowing in the stimulus circuit. An A.C. microammeter measures this current directly. Current strength may be varied continuously by changing the resistances in series with the subject. The electrodes consisted of a silver disc 17 mm in diameter and a rounded silver wire 1 mm in diameter, embedded 8 mm apart in a piece of bakelite.

Threshold determinations were made on four skin areas, two each on the dorsal surface of the left forearm and on the forehead, in the following order: arm, head, head, arm. The "method of minimal changes" was used, with two "ascending" and two "descending" series for each spot. On a second day the experiment was repeated with 14 of the 15 subjects.

The mean of 240 threshold determinations made on the first day—irrespective of subject or of skin area—was 15.96 microamperes. The range of the thresholds was from 2.25 to 65 microamperes, while the standard deviation was 8.78 microamperes. If these variability indices are converted into relative units, the range represents a variation about the mean of approximately -80 to $+300$ per cent., while the standard deviation is $\pm$ 55 per cent. of the mean. The repetition of the experiment yielded slightly higher figures for the mean and standard deviation (18.18 ± 10.14), but the relative variability remained almost unchanged (S.D./Mean = 56 per cent.).

The variability of these pain threshold measurements is markedly greater than that reported by Hardy and his collaborators for thermal stimuli. Their standard deviation represented a variation

[10] Nessler and Kuttner-Lichtenstein techniques modified (see O. Schales, R. V. Ebert and E. A. Stead, Jr., *Proc. Soc. Exp. Biol. and Med.*, 49: 1, 1942; T. D. Fontaine, *Jour. Indust. and Eng. Chem.* (*Anal. ed.*), 14: 77, 1942) and adapted to Coleman spectrophotometer.

[1] J. D. Hardy, H. G. Wolff and H. Goodell, *Jour. Clin. Invest.*, 19: 649, July, 1940.

[2] G. A. Schumacher, H. Goodell, J. D. Hardy and H. G. Wolff, SCIENCE, n. s., 92: 110, August 2, 1940.

[3] F. A. Fender, SCIENCE, n. s., 89: 491, May 26, 1939.

about the mean of ± 1 per cent., whereas the corresponding coefficients of variation in our two sets of measurements were greater than 50 per cent. But their frequency distribution was based upon averages of all threshold determinations for each subject, and such values would normally show less variation than a distribution of single threshold measurements. Similar average thresholds have been computed from our data, and means, standard deviations, and coefficients of relative variability have been determined. For the first day's averages, these three measures were as follows, in microampere units: mean, 16.06; standard deviation, 7.86; S.D./Mean, 49 per cent. Corresponding values for the second day were: mean, 18.0; standard deviation, 8.12; S.D./Mean, 45 per cent. These indices of relative variability are somewhat lower than those for the single measurements, but they are still almost fifty times as great as the value reported for thermal stimulation.

These results show definitely that pain thresholds for this form of electrical stimulation are not uniform or constant in different individuals. A further question arises as to the constancy of sensitivity in the same individual. Does the subject with a low threshold for one series of measurements continue to exhibit the same level of sensitivity in subsequent tests in the same area, in different areas, or on different days? In order to test the reliability of these thresholds, rank-difference correlation coefficients have been computed between several series of measurements. First, the averages of all thresholds for one day were correlated with those for the second day, and the coefficient was .55. This represents a moderately high degree of correlation, but it is far too low for accurate prediction of an individual's standing from one day to the next. It should be noted, however, that one half of the subjects had almost identical ranks on the two days, while the other half exhibited the variability which lowered the correlation.

The consistency of the two sets of threshold measurements made upon the same spot was next determined. The correlations were high between the averages of each of these two series, for all four of the spots tested on the first day. The coefficients were .86, .91, .89 and .94, for arm, head, head, arm, respectively. But the correlations between average thresholds for different spots in the same body area were much lower, varying from .32 to .44. Finally, averages of all threshold determinations made for the arm on a given day were correlated with corresponding averages for the forehead. The correlations of two sets of such values, secured on the two days, were exactly the same, the coefficient in each case being .60.

It is clear from these correlations that the electrical pain threshold of an individual may vary considerably from day to day, and from one skin area to another. Certain subjects are relatively stable, while others fluctuate over a wide threshold range. Further study of the conditions of such individual variability is needed.

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THE EFFECT OF SODIUM BICARBONATE ON THE THIAMINE CONTENT OF PEAS[1]

IT is generally believed by nutritionists that cooking with sodium bicarbonate results in the destruction of a large proportion of the thiamine content of foods. In order to obtain definite data on this subject, the experiments recorded in Table 1 were carried out with fresh and frozen peas.

TABLE 1*

Type of peas and method of cooking	No. of tests	Time of cooking	pH of water after cooking	Thiamine in gamma: Per 100 gm peas	In total cooking water	Total
		min.				
Frozen-Type I†						
Raw	3					408
Water-cooked	3	6	7.66	326	90	416
Sodium bicarbonate-cooked	3	4	8.77	330	44	374
Frozen-Type II†						
Raw	1					351
Water-cooked	1	6		238	102	340
Sodium bicarbonate-cooked	1	4	8.70	193	25	218
Fresh						
Raw	4					333
Water-cooked	4	17	7.29	257	78	336
Sodium bicarbonate-cooked	4	8	8.84	258	63	321

* In all tests 85 gms of peas were cooked with 180 cc of water. In sodium bicarbonate tests 0.22 gm of sodium bicarbonate was added.

† Type I represents a brand of peas prepared by tunnel freezing; Type II, plate freezing.

The average time necessary to complete the cooking of the peas was determined in separate tests where it was found that sodium bicarbonate greatly reduces the time of cooking. Thiamine was determined by a modification of the fermentation procedure of Schultz, Aiken and Frey.[2] The applicability of the above method of biochemical determination was confirmed by bioassay of dried ground water-cooked and sodium bicarbonate-cooked peas by the method of Kline, Hall and Morgan.[3]

The greater loss in thiamine found in Type II of the frozen peas is probably to be ascribed to the partial mashing of the peas by this method of freezing.

[1] This investigation was aided by a research grant from the Church and Dwight Company, Inc.

[2] A. S. Schultz, L. Aiken and C. N. Frey, *Ind. Eng. Chem., Anal. Ed.*, 14: 35, 1942.

[3] O. L. Kline, W. L. Hall and J. F. Morgan, *Jour. Asn. Off. Agr. Chem.*, 24: 147, 1941.

In another series with fresh peas which were overcooked to the extent of rupture of the hulls, an average destruction of 35 and 57 per cent. of the original thiamine occurred when cooked with water or water and sodium bicarbonate, respectively.

The experiments indicate that no greater destruction occurs in the thiamine remaining in the intact pea after cooking with sodium bicarbonate than when water alone is employed. Slightly greater destruction results in the thiamine leached out of the pea during cooking. The loss only amounts to 8.3 per cent. in the frozen peas and 3.6 per cent. in the fresh peas cooked with sodium bicarbonate.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR DETERMINATION OF THE BACTERIAL CONTENT OF AIR[1]

A number of devices have been employed for determining the bacterial content of air. To be satisfactory, such a device must trap all or nearly all the air-borne microorganisms, must allow quantitative recovery of the bacteria for counting, must allow sampling of a large volume of air so that the sample obtained is representative, and must be simple and convenient to operate under field conditions.

The Wells centrifuge has perhaps been used most widely for bacterial air analysis. Theoretical considerations and experimental data have been put forth by Phelps and Buchbinder[2] showing that only those bacteria carried on droplet nuclei greater than a certain minimum size can be retained by the Wells Centrifuge. Wheeler, Foley and Jones[3] have suggested bubbling air through glass beads immersed in broth, as had been done by Robertson and associates.[4] In experiments testing the recovery of bacteria from room air, Wheeler showed that the glass beads device recovered eight times as many bacteria per cubic foot of air as the Wells centrifuge. A discussion of the merits of other bacterial samplers is given by Bourdillon, Lidwell and Thomas.[5]

The apparatus described in the present paper and pictured in Fig. 1 utilizes the principle of atomization to coat the bacterial particles with a layer of liquid.[6] The mist thus produced is carried into the second chamber of the collector, where it is bubbled through liquid which absorbs the droplets.

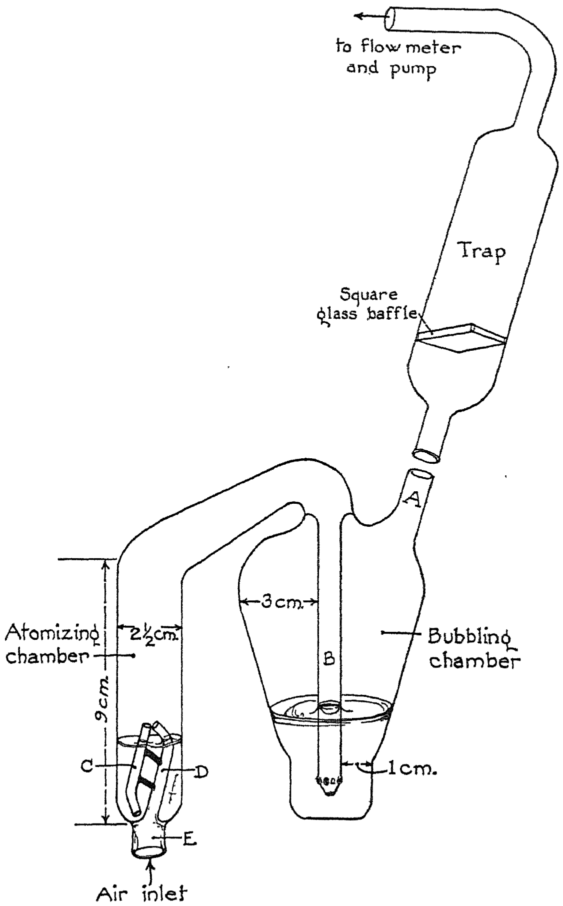

Fig. 1. Atomizer Collector for bacterial air analysis. The capillary, C, is about 1 mm, inner diameter; D is about 1.5 mm, inner diameter, at the tip. At the bottom of tube B are five holes 1 mm in diameter.

The procedure of operation is as follows: Fifteen cc of sterile broth plus two drops of sterile olive oil are pipetted into opening A of the apparatus which

1 This investigation was aided in part through the Commission on Cross Infections in Hospitals, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Division, Office of the Surgeon General, United States Army.

2 E. B. Phelps and L. Buchbinder, *Jour. Bact.*, 42: 321, 1941.

3 S. M. Wheeler, G. E. Foley and T. Duckett Jones, Science, 94: 445, 1941.

4 O. H. Robertson, Edward Bigg, B. F. Miller, Zelma Baker, Science, 93: 213, 1941.

5 R. B. Bourdillon, O. M. Lidwell and J. C. Thomas, *Jour. Hygiene*, 41: 197, 1941.

6 The Palmer water sampler for dust collection also has made use of this principle, G. T. Palmer, *Amer. Jour. Public Health*, 6: 54, 1916. S. H. Katz, G. W. Smith, A. M. Myers, L. J. Trostel, Margaret Ingels and Leonard Greenburg, *Pub. Health Bull.*, No. 144, 1925.

has been sterilized by autoclaving. Olive oil prevents the building up of foam masses, which would cause loss of the scrubbing fluid through bubbling over. Sufficient fluid is forced up tube B (either by tilting or by applying gentle air pressure at A) and poured into the atomizing chamber until the liquid level reaches a point about five mm below the top of the capillary tube C. The apparatus is then connected with sterile precautions to the trap[7] with a short piece of rubber tubing and air is drawn through the system by means of a small suction pump[8] at a rate measured by a calibrated flowmeter.

The air enters the inlet E and is directed through nozzle D into a jet which blows across the capillary tube C, as is done in the Graeser[9] atomizer. Liquid is thus drawn up into the capillary and atomized into the air stream. The droplets so produced either fall back into the liquid in the first chamber or else are trapped in the second chamber, where the air is bubbled through the holes at the bottom of tube B.

It was found convenient to take 10- to 15-minute samples at a rate of about three quarters of a cubic foot per minute. At the end of this time the atomizer is tilted so that all the fluid is poured into the bubbling chamber and trap. The liquid may be poured back and forth to wash off any bacteria remaining on the walls of the chambers and trap. Two tenths, 0.5 and 1.0 cc portions of the fluid in the sampler are removed for blood agar pour plates. From these plate counts the total number of bacteria in the sample are computed, and since the air volume is known, the bacterial count per cubic foot of air may be calculated. It is necessary to apply a correction factor because of loss of fluid due principally to evaporation. This correction factor is nearly constant for different samplers and varies with the relative humidity. For 10 cubic foot air samples the fluid loss varies between 1.8 cc and 3.2 cc at humidities of 70 per cent. and 30 per cent., respectively, so that an average correction of 2.5 cc may be used. This loss apparently does not interfere with the efficiency of bacterial collection.

This bacterial air sampler has been tested extensively in laboratories, offices and lecture rooms, as well as in unoccupied rooms into which broth cultures of bacteria or dried dust-suspended microorganisms had been sprayed. The completeness of removal of bacteria from the air was determined by passing the air emerging from the exhaust end of the trap through various bacterial sampling devices to determine the percentage of bacteria which had escaped. The data of Table I are representative of the results obtained.

TABLE I

Kind of air sampled	Arrangement of samplers	Bacteria per cubic foot
Normal air of inhabited room	Atomizer sampler with its exhaust connected to a Wheeler glass beads sampler	Atomizer sampler: 508 Wheeler sampler: 6.5
Air into which a mixture of Staphylococcus Albus and Pneumococcus Type I broth cultures was sprayed	Two atomizer samplers in series	*1st atomizer sampler:* 22,400 staphylococci 4,080 pneumococci *2nd atomizer sampler:* 71 staphylococci 51 pneumococci

Relative completeness of collection was also tested by simultaneously sampling the air of a room with several different types of bacterial collectors. Data from a typical experiment are presented in Table II.

TABLE II

COMPARISON OF EFFICACY OF BACTERIAL COLLECTION BY THE WELLS CENTRIFUGE, THE WHEELER GLASS-BEADS COLLECTOR, AND THE ATOMIZER SAMPLER. IN EACH EXPERIMENT THE COLLECTORS WERE OPERATED SIMULTANEOUSLY AT THE SAME LOCATION IN THE ROOM

Kind of air sampled	Samplers compared	Bacteria per cubic foot
Normal room air	Wells Centrifuge	9.3
	Atomizer Sampler	160.00
Room air into which a suspension of Staphylococcus Albus and Beta Hemolytic Streptococcus Group C had been sprayed	Wheeler Glass-beads Sampler	46,800
	Atomizer Sampler	53,040

On the average, the Wheeler sampler recovered 86 per cent., and the Wells centrifuge 15 per cent. of the bacteria collected by the atomizer sampler.

The atomizer type of bacterial sampler here described has been found very simple and convenient to operate. Loss of a sample through contamination or other reasons almost never occurs. This sampler can be easily made by a competent glass blower. The auxiliary equipment is inexpensive and available.

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[7] Purchasable from scientific supply houses. The trap may be sealed directly to the apparatus.

[8] Suction pump was purchased from V. Mueller Company, Chicago, and was driven by a 1/6 H.P. motor.

[9] J. B. Graeser and A. H. Rowe, *Amer. Jour. Dis. Child.*, 52: 92, 1936.

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SCIENCE NEWS

Science Service, Washington, D. C.

SCIENCE IN 1942

Psychology and Psychiatry

(*Continued from p. 10, January 1*)

Rats so sensitive to noise that they would be thrown into fits by a shrill sound were made immune for days to such sounds by a two-week treatment in which the fit-producing noises were preceded by harmless sounds.

A muscle of the ear, the stapedius muscle, was found to serve as an automatic damping agent to protect the inner ear against excessive noise—perhaps partly explaining why loud noise temporarily deafens.

Airsickness and other types of motion sickness, although originally due to action of the balancing mechanism in the inner ear, is often the result of conditioning to other sights, smells and motions, and if so can often be prevented and cured by psychological means.

Some cases of weakness in distinguishing colors can be relieved by doses of vitamin A.

Individuals who have recently received doses of the sulfa drugs may make wrong decisions because of mental confusion that sometimes persists after this treatment.

The bizarre craving to eat dirt may be caused by diet deficiency rather than mental illness is shown in a survey of the diet of school children.

Radio in the farm districts increases the contentment of those who are well-adjusted to farm life, and increases discontent among the ill-adjusted.

Hallucinations can be produced in normal individuals by the simple form of learning known as conditioning.

The traumatic neurosis of this war, seemingly more severe than the "shell shock" of last time, is expected to take more physical forms such as peptic ulcers and heart complaints, with less functional paralysis; effective treatment combines hypnosis or hypnotic drugs with psychoanalytic methods.

Evidence that the way insulin shock treatment aids the metally ill is by making them forget recently acquired abnormal ideas and behavior was furnished by experiments in which newly acquired learning was forgotten after insulin treatment while older, more thoroughly drilled habits were retained. Similar results were obtained in human schizophrenic patients treated with metrazol shocks.

Sub-shock doses of electric current through the brain were found to shorten the duration of delirium tremens following prolonged alcoholism.

Pneumoencephalography, invaluable in the location of intracranial tumors, was proved to be prognostically misleading in cases of so-called cerebral atrophy; in spite of x-ray evidence of atrophy, behavior development was found to proceed normally.

Engineering and Technology

Puffed up sand, known as silica aerogel, was introduced as a heat insulator twice as effective as any other substance.

Glass that floats in water and replaces cork, balsa, cellular rubber or kapok in life preservers and life rafts, was made by foaming glass with carbon additions during manufacture.

A continuous fermentation process was developed to convert molasses into alcohol in three to five hours.

A method of heat treating iron or steel in inert atmosphere or vacuum furnace was demonstrated to remove or prevent scale formation.

Plastic coatings were used to replace tin upon cans for many uses, including food packing.

Non-metallic containers of various sorts were introduced to replace tin cans in many industrial uses.

A new electroplating process saved half the tin that goes into a tin can and saved electric power and half the time of plating.

Steam acidified with gluconic acid was used to clean milk cans more quickly.

Induction heating furnaces, operated by electron tubes, were used to coat and flow tin on iron sheet in tin plating process.

A new plastic that can be kneaded and thrust into leaks in life boats was put into use.

Foods, such as lard, were made to refrigerate perishable goods on overseas journeys by being chilled to sub-zero temperatures and placed about the foodstuffs to be kept chilled.

Soldier's V-mail was transported overseas as microfilm and photographically enlarged for delivery.

Heavily coking bituminous coals were successfully burned in household furnaces by use of improved underfed stokers.

Synthetic glass jewels were made in America for pivot bearings of small instruments.

Iron was substituted for printing plates of nickel and copper in experiments.

Chemically toughened wool, resistant to moths and soap, was developed.

A new inflatable rubber pontoon was substituted for the standard aluminum boat for temporary bridges formerly used by the Army, saving rubber by reducing the truck transport needed.

A "pancake" Diesel engine for Navy subchasers was announced as in production.

A wire "umbrella" was developed to protect explosives plants and oil storage from lightning.

Cellulose acetate now completely replaces silk as an insulation for telephone wires with considerable improvement.

Transoceanic telephone cables now seem to be practicable due to the invention of a telephone repeater which can be built into the cable structure itself.

Method of wiping lead joints on telephone cables was brought into use, which saves about 60 per cent. of the usual requirements of tin.

A method of producing x-ray photographs that show three dimensions on a single film was demonstrated.

Merchant shipbuilding facilities were expanded to the point where there are more than 60 yards, with 300 ways and nearly 2,000,000 workers, producing 8,000,000 tons of shipping in 1942.

Cargo ships of 10,500 tons were completed from keel laying to launching in $4\frac{3}{5}$ days and from launching to delivery in eight days.

Side-launching of ships was used extensively in war shipbuilding program.

Aeronautics

Solution of certain research problems—development of new low-drag wing sections, improvement of flaps, improvement of cooling systems, improved engines and new propeller designs—made it possible for America to build planes to fly faster than 400 miles per hour.

Cylinder heads made by forging in a die, with fins cut on the exterior by a high-speed milling machine, made possible reduction in weight of airplane engines to less than one pound per horsepower.

A portable catapult was developed for land launching of airplanes.

Modification of battle-tested airplanes made possible the development of a new technique of air warfare—low flight at high speed for horizontal bombing, and use of the plane as a fighter when bombs have been dropped.

Inboard bomb racks for wide-hulled flying boats, with guides to "steer" bombs over the side and start them accurately downward, were invented.

Auxiliary turbo-driven propellers for getting rocket planes up through the denser lower atmosphere were invented; they are powered by the rocket blast, and are to be jettisoned once the plant has reached the stratosphere.

New multi-engined transition training planes for instruction of flight crews were developed and put in use.

Pre-flight aviation training was introduced as a regular part of the curriculum in elementary and secondary schools.

A new telescopic sight for rear gunners made possible wider arc of fire and better streamlining of the fuselage.

Apparatus for automatic control of the pressure within a sealed airplane cabin by blowing off to outside air when pressure is high and turning on a supercharger when it falls, was invented.

A cooling meter for aircraft engine cooling, and meters for measuring the visibility of exhaust gases from airplane engines were developed.

A de-icer for airplane propellers that provides for the forcing of anti-freeze chemical through a series of holes when the propeller is rotated, was patented.

A device was developed that warns the pilot of approaching stall conditions by means of a tube which transmits pressure changes from the trailing edge of the wing to a diaphragm within the wing connected with an electric instrument.

Caterpillar-type treads for airplane landing gear were invented.

A new ordnance mount for machine guns, combined with gunner's seat mounted on a circular track, was developed for enabling the gunner to swing himself and his weapon around to fire at any angle and if necessary to pilot the plane.

Medical Sciences

Lowest death rate in the history of the United States death registration area and an all-time record low in smallpox cases, recorded in 1941, were reported, after an interval for collection of figures, in 1942.

For the first time in medical history, disease-fighting substances in the blood known as antibodies were formed artificially in laboratory flasks, confirming the theory of molecular changes in immunization.

First direct evidence of human need for certain amino acids in protein foods was discovered in diet studies with human volunteers which showed that arginine is required for spermatogenesis, lysine plays a role in the female reproductive cycle, and tryptophane is also essential, lack of it leading in rats and possibly also in humans to baldness and sex gland atrophy in males and to teeth defects and cataracts in young, growing animals.

First, and strikingly successful, use of the Moorhead Foreign-Body Finder, which uses a radio frequency circuit with movable coil and steel finger to detect shell fragments and the like in war wounds within a few minutes instead of hours as by X-ray and probe, was reported from Pearl Harbor.

Efficient U. S. Army system of evacuating the wounded under fire, sulfanilamide and blood plasma banks scored a notable triumph in saving lives at the Pearl Harbor raid, where almost 100 per cent. of abdominal wounds healed without infection, less than 4 per cent. of compound fractures and flesh injuries became infected.

Propylene glycol vapor was found to be a safe, effective substance for destroying influenza virus and other germs in the air in laboratory experiments and was credited with reducing significantly respiratory infections among 16 children in the ward of an institution where it was tried.

Experimental use of a 10-hour combined chemical and fever treatment of syphilis and, on a wider scale, of six to ten-week intensive chemical treatments were announced.

Discovery that ants are capable of spreading dysentery was announced.

Discovery of chemicals, probably enzymes, in the bodies of young mice which destroy the drug-resistant waxy parts of the tuberculosis germ were announced with some hope of development of an enzyme preparation that might be used in the treatment of tuberculosis.

Hope for a chemical conquest of tuberculosis was encouraged by announcement of successful results in treatment of patients with a relatively new drug, Promin, and by announcement of even greater success in treatment of tuberculous animals with a related chemical, di-amino-diphenyl sulfone.

Reduction of venereal disease in the Army to a rate of 38.2 per 1,000 for the first six months of 1942, with a syphilis rate the lowest in Army history, was accomplished following establishment in the Surgeon General's office of a division of venereal disease control with officers assigned to each large Army camp and each of the larger tactical units.

(*To be concluded*)

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SIR JOSEPH LARMOR AND MODERN MATHEMATICAL PHYSICS

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SIR JOSEPH LARMOR, MATHEMATICAL PHYSICIST

ON May 19th last the scientific world lost a notable mathematical physicist, Sir Joseph Larmor, Lucasian professor of mathematics at Cambridge, England, from 1903 to 1932, successor to Sir George Stokes in this celebrated chair once held by Sir Isaac Newton. After being graduated from Queen's College, Belfast, Larmor took highest honors in the Cambridge Mathematical Tripos of 1880 at about 23 years of age, J. J. Thomson being second wrangler in the same year. Larmor was called at once as professor of natural philosophy to Queen's College, Galway, where he remained until 1895. He then returned to St. John's College, Cambridge, as lecturer, and was named for the Lucasian professorship in 1903. From 1901 to 1912 he was secretary of the Royal Society, and was awarded the Copley Medal of the society in 1921. Always deeply attached to his native country, Ireland, he entered Parliament in 1911 as Unionist representative of Cambridge University and served there for eleven years. He received various distinctions besides those mentioned.

Larmor grew to scientific maturity at a time when every attempt was being made to explain all physical phenomena on a dynamical or at least a quasi-dynamical basis, involving the concepts of absolute space (the ether), of absolute time and simultaneity, of

mass and force, characteristic of the Newtonian era of physical speculation. Larmor was already forty-three years of age when Planck in 1900 propounded his revolutionary idea of quanta of energy, destined to modify profoundly the current of physical ideas. In 1905 Einstein formulated his justly celebrated special theory of relativity, which was equally subversive of accepted classical ideas.

Up to that time Larmor and his great compeer, the Dutch mathematical physicist, H. A. Lorentz, were both well in the van of the group attempting to reconcile current dynamical and electrodynamical theories, and in particular to explain the null effects of the famous Michelson-Morley experiments of 1887 and other attempts to ascertain the absolute motion of the earth in space. It had occurred somewhat earlier (around 1892) to another noted Irish mathematical physicist, Fitzgerald, as well as to Lorentz, that there might occur a minute contraction of length in the direction of motion, often called the "Fitzgerald-Lorentz contraction," which would explain such null results. But it was Larmor who, working independently in the same circle of ideas, began to undertake a thoroughgoing mathematical study of the whole situation involved.

The outcome was his great book "Aether and Matter" of 1900, which was perhaps his crowning achievement. As he states in the Introduction, "a complete formal correlation is established between the molecular configurations of a material system at rest and the same system in uniform translatory motion, which holds good as far as the *square* of the ratio of the velocity of the system to the velocity of radiation. This correspondence carries with it as a consequence the null result, up to the second order, of the very refined experiments of Michelson and Morley. . . ." Beyond the second order of this velocity ratio, Larmor was not much interested, since such small effects would be well outside of the range of experimental determination. Indeed, the whole spirit of the work, in a mathematical sense, is extremely close to that of Einstein's later special theory of relativity of 1905, as the above quotation sufficiently shows, even if the concept of the ether as a particular frame of reference is employed.

Larmor goes so far in this book as to speculate concerning the explanation of gravitation from the same point of view. In a section with the title "Are the linear equations of the Aether exact?" (p. 186), he asks boldly: "Why then should not relatively minor phenomena like gravitation be involved in similar non-linear terms . . . in the analytical specification of the free aether . . .?" At the end he concludes somewhat in favor of the "natural prepossession" that the equations are truly linear, and so against his own extremely interesting suggestion.

The now familiar complete ("relativistic") form of the ponderomotive forces of the electromagnetic field and the corresponding Lorentz (or Larmor-Lorentz!) transformations are used in this notable work. This was essentially completed in 1898 (see the Preface). It was not until the end of 1903 that Lorentz's important article on electromagnetic theory in the German Mathematical Encyclopedia appeared. In his later article on "Relativity" in the Encyclopedia (1920), Pauli has stated the case thus (section 1, my translation):

> Now it became important to work this "Lorentz-contraction" organically into the theory, and also to clear up the other negative attempts to find an influence of the earth's motion upon phenomena. Here Larmor is to be mentioned first, who already in 1900 set up the formulas now generally known as the Lorentz transformation, and thus also had in view the variation of time-measurement. Lorentz's comprehensive article which was finished at the end of 1903, added some brief comments, which were to show themselves later very fruitful. . . .

Larmor himself has said a generous final word of appraisal on this question of priority. (Appendix II, (1927) "On Relativity and Convection," Vol. 1, Mathematical and Physical papers (1929)):

> This transformation was developed for the complete scheme of the electric equations of the field . . . in *Aether and Matter* (1900), Chap. XI, but only up to the second order of v/c; being so restricted on the tacit ground that the finite size of the electrons . . . must in any case introduce uncertainty beyond the order of 10^{-10} [cm.]. . . . This complete scheme for the electromagnetic field *outside the atomic sources* was obtained in exact form independently by Lorentz (1904) . . .; and the correspondence leading to it is appropriately called by his name as having been the initiator . . . in 1892.

Under the impact of the radical new theories, Larmor refused to abandon without further consideration the classical point of view which had served so well. He had realized very clearly how dynamics and electrodynamics were united deeply by means of the Principle of Least Action of Lagrange and Hamilton to which he always attached the greatest importance. However, there was a definite difference between his apologetic attitude for his lack of active mastery of quantum mechanics and its spectroscopic applications, and his repugnance, not so much towards relativity as for the setting in which it had been presented. Regarding the first, he says in the Preface to the second volume of his Papers: "the modern constructs in the problems of quantified spectroscopy . . . highly successful in their special fields . . . have hardly been entered upon [by himself], because the vast and tentative literature could not be justly appreciated except by a critic closely cognizant of the diverse evolutions of the last fifteen years in this field of knowl-

edge." But, regarding the second, he speaks of special relativity as follows in the Appendix quoted above: "All convection, uniform translatory motion [in free, *i.e.*, empty aether], would then be indeterminate, there being no standard frame in which to locate it . . .: it in no way discredits the theory of an aether, unless the intrinsic atoms of matter can be abolished also." Larmor characterizes Einstein's postulate of relativity as an "algebraic correspondence," "masquerading in the language of kinematics." The second gravitational theory of relativity of Einstein (1915) is epitomized as an "auxiliary construct," while "the absence of space and time and motion in the auxiliary construct is against reality."

It is distinctly interesting to observe that although Lorentz followed the brilliant new theories with all attention and determination, yet there remained in his mind vestiges of similar feelings. Thus he states in his Leyden Lectures 1910–12 (Silberstein-Trivelli's translation): "If we do not like the name of the 'aether' we must invent another name as a peg on which to hang all these things," and "can not deny to the bearer of all these properties a certain substantiality; and if so, then one may in all modesty call true time the time measured by clocks which are fixed in this medium and consider simultaneity a primary concept."

One may sympathize with, and admit the accuracy in detail of Larmor's position in regard to the relativistic theories: it is true that the work of Fitzgerald, Larmor, Lorentz and Poincaré had shown the special theory of relativity to be "just around the corner"; but it was only Einstein who grasped the significance of the actual situation. It is likewise true that the general theory of relativity of 1915 has not effectively entered into physical speculation; yet this second achievement of Einstein has also exerted a considerable influence on the course of physical thought. In fact it has been Planck and Einstein together who have broken the magical spell which the classical concepts of Newton had cast over scientific and philosophical thinking.

Larmor's mathematical-physical contributions extend over the entire classical field. His papers are extremely thoughtful and always repay careful reading. In the field of electromagnetism his contributions have been especially influential. Larmor's formula for the rate of radiation of energy from an accelerated electron is well known to all physicists, and the dispersion formulas due to him and Lorentz have been very useful.

When occasion required, he brought in subtle mathematical considerations, and always had the greatest appreciation of purely mathematical work. Indeed a number of his papers are essentially mathematical in character. His Presidential Address of 1916 before the London Mathematical Society, "The Fourier Harmonic Analysis and its Scope in Physical Science," shows a deep intuitive insight into the nature of these remarkable series, and a wide knowledge of their extremely varied applications.

Larmor was a well-known and much valued figure at International Mathematical Congresses, being a participant in the Rome Congress of 1908 and the three succeeding congresses at Cambridge, England (1912), at Strassbourg (1920) and at Toronto (1924).

The unmistakable impression which one gathers from his activities and writings, and from accounts by those who have known him, is that of a life of absolute sincerity and of unselfish devotion to the highest ideals, scientific and personal. He had a deep sympathy with younger people as witnesses, for example, his bequest to the University of Cambridge for medical and surgical assistance to the younger members of the faculty.

His own attitude is clearly revealed at the end of the first part of his Presidential Address, referred to above, where he tries to look forward in the midst of the First World War to "the promise of nobler and more disinterested times." Perhaps, in the midst of the second World War, we could not close in any way that would be more in accord with his outlook upon life than in voicing, as he did, the hope expressed by Shelley:

> The world's great age begins anew,
> The golden years return,
> The Earth doth like a snake renew
> Her winter weeds outworn.
> . . . . .
> A brighter Hellas rears its mountains
> From waves serener far,
> A new Peneus rolls his fountains
> Against the morning star.

WHAT MORE CAN ENGINEERING COLLEGES DO THROUGH ESMWT?[1]

By Dean GEORGE W. CASE

DIRECTOR OF ENGINEERING, SCIENCE AND MANAGEMENT WAR TRAINING DIVISION (ON LEAVE AS DEAN OF THE COLLEGE OF TECHNOLOGY, UNIVERSITY OF NEW HAMPSHIRE)

THIS topic is stated as a question. In line with the policies established since this program began, the effort will be to furnish information that may be useful to the institutions in answering the question

[1] Address at the fifty-sixth annual conference of the Association of Land-Grant Colleges, Chicago, October 28, 1942.

for themselves. This information will be in the nature of a progress report covering the period since Dean Seaton's report as director of ESMDT, made to this group one year ago.

By way of review, you may recall that the EDT program, starting in December, 1940, and with all courses closing before September 30, 1941, had a total of 120,000 enrolments. The ESMDT program, which was getting well under way one year ago, had a total for the year of about 438,000. In the current program, which is called Engineering, Science and Management War Training (ESMWT), the last available report shows 107,000 enrolments in classes active or completed. In addition, courses have been approved to start with additional authorized enrolments of 160,000.

The appropriation for the EDT program was \$9,000,000, of which about 8¾ million had been allotted to approved courses at the close of the fiscal year. The ESMDT program had an original appropriation of 17½ million dollars, and a supplemental appropriation of 3 million, which unfortunately was not available until about May 1. This made a total of 20½ million available, of which about \$20,300,000 was allotted to approved courses at the close of the fiscal year on June 30, 1942. The ESMWT program has an appropriation of 30 million dollars. This program started off very actively on July 1 with about 500 course proposals on hand to be approved as soon as the fiscal year had begun. Since July 1, proposals have been approved at about the rate of 1,000 per month, and with the preliminary estimated costs amounting to about 3 million dollars per month or at the rate of 36 million dollars for the fiscal year. It may be expected that the program will accelerate after the summer months are over, and on this basis an appropriation of 30 million dollars hardly looks sufficient. However, the office has learned by experience to expect a decrease of 20 to 30 per cent. between the cost estimates on preliminary proposals and the actual cost of the courses due partly to estimates being for a maximum enrolment. It appears from the figures available so far that the needs for training will make full use of the appropriation, or that they may somewhat exceed the appropriation. However, up to the present time, it has not been considered advisable to seek a supplemental appropriation.

In the plans for a program for 1943–44, a budget request has been submitted for an appropriation of 40 million dollars. This is based upon estimates of the Department of Labor that an employment peak for war workers will be reached about December, 1943.

There have been a number of developments in the nature of the program, one of the most significant of which is the increase in the number of women being trained. In the EDT program, the enrolments of women amounted to 811 out of a total of 120,000, or less than .7 of 1 per cent. In the ESMDT program, the enrolments of women amounted to 38,000 out of a total of 438,000 or nearly 9 per cent. In the ESMWT program, the enrolment of women has been running about 16 or 17 per cent. and is expected to increase.

A large number of the women are being enrolled in engineering drafting courses; others in ordnance inspection courses; still others in courses for the training of chemical technicians; and a number in the management field. The Civil Service Commission is requesting a full-time course of about ten weeks by which they hope to qualify women graduates in arts and sciences to take positions as junior engineers in federal services for which the commission recruits personnel.

Another trend in the program which appears to be increasing is full-time courses in which the students receive pay while they are in attendance in the course. This practice was established by the Army and Navy in such courses as Ordnance Inspection, Radio Inspectors or Technicians, etc. These courses, which include only civilian personnel, have run in length from about eight weeks to 26 weeks. In addition, the number of courses for commissioned officers has increased somewhat.

During this calendar year, full-time courses in which industry paid the students while attending have appeared in California and New Jersey. The number of such courses is small at the present time, but it does appear that industry in a number of states is interested in this method of securing trained employees. They are experimenting with it cautiously. If their needs become more urgent, this program may include more full-time courses on this basis.

The Civil Service Commission is also interested in the organization of courses on this full-time basis with pay. In these cases, the pay of the trainees would have to come from the departments of the government in which the trainees are to be employed. It is not certain at the present time how far this movement will go.

One development worth noting is the effort of the Civil Service Commission to make use of training which has already been given in ESMDT and ESMWT courses. The commission has taken from the files the names of several thousand trainees in fields in which they had urgent demands. They are sending application forms to these men at the rate of 2,500 per week and they report that they have secured applications from about 6 per cent. of this group. In order that the program may provide this service to the Civil Service Commission without interfering with the plans of industry, enrolment cards of men destined for industry should be stamped "Industry"

before being sent to Washington. The commission has also established the practice of surveying the lists of courses as they are approved, and attempting to get applications from the trainees in selected courses while the courses are in progress. About 3,000 trainees are being contacted per week in this manner at the present time, but it is too early to know how successful this effort will be.

One year ago the ESMDT program was engaged in the establishment of the course in Ultra-High Frequency Techniques at 40 engineering schools to meet an urgent need in the manufacture, operation and maintenance of aircraft detection equipment. The establishment of this course was preceded by an instructors' conference at the Massachusetts Institute of Technology, held in November, 1941. Before the fiscal year had closed, this course had been conducted in 45 institutions and had been given to about 1,100 senior students in electrical engineering or with majors in physics. At the close of the school year, the number that had been secured by the Army and Navy for the operation and maintenance of their aircraft detection equipment was small due to delay in contacting the men. Since that time, however, it appears that others have gone into the Army or Navy for this type of service.

During April and May, the institutions which had conducted these courses secured from their previous electrical engineering graduates about 1,100 applications for commissions in the Army or Navy, to enter upon this specialized field. From these applications, nearly 400 men were commissioned and sent to special full-time courses, including the Ultra-High Frequency Techniques. These men are now in service.

The schools are equipped and are willing to train additional groups of commissioned officers selected from the graduates of previous years, but the difficulty lies in finding such groups to be commissioned and trained. A recent canvass by the ESMWT office of 3,300 graduates secured less than 100 replies, indicating a lack of interest in commissions and training for this field. It appears that the primary service of the schools in Ultra-High Frequencies will be found in giving this course to their senior students.

During the summer, 20 additional institutions were authorized to conduct this course for their seniors, and a second instructors' conference was held at the Massachusetts Institute of Technology about September 1, at which representatives of 60 institutions were present. It is expected that in the 65 institutions participating in this work during the present school year approximately 1,300 senior students will receive the training, and it is evident that this year the Army and Navy intend to be much more prompt in contacting these men and securing more of them for the armed forces.

During the year the program had some experience in using radio broadcasting. The National Association of Broadcasters and associated stations, upon requests or encouragement from the Army and Navy, conducted a vigorous campaign of soliciting students in Fundamentals of Radio and the ESMDT office went along with this effort for a few weeks. It soon became evident, however, that this method of contacting and enrolling trainees had two serious faults. First, the number that could be enrolled by this method in a popular subject like radio was much more than the ESMDT funds could care for. Second, the method was not sufficiently selective. In the flood of applications most institutions were unable to select those who were likely to enter radio industry or radio service in the armed forces, and too large a percentage of the training appeared to be serving no immediately useful purpose in the war effort. Accordingly, this method of enrolment was discontinued.

There was and is, however, an urgent need for radio technicians, and when the supplemental appropriation became available, this training was resumed in a more orderly way with enrolments to be restricted to those employed in the radio industry, those enlisted in the Signal Corps reserve or those who were definitely headed for one of these services. Radio announcements have recently been used again quite successfully by having the announcement made or controlled by officers of the school or of the Signal Corps.

The complete story indicates that carefully controlled radio announcements, coupled with careful selection of applicants, may be quite useful, but that an uncontrolled broadcasting campaign is hardly compatible with efficiency in training for immediate service.

The ESMWT director and staff are constantly facing questions as to what may be included under this program. The Appropriation Act provides for courses to meet the shortage of engineers, chemists, physicists and production supervisors in fields essential to the national defense. It is always embarrassing when a well-planned course to meet some really urgent need must be disapproved on the ground that it has not been legally authorized in the act. But the Budget Bureau and Congressional committees have made it clear that even in this war emergency this limitation in the Appropriation Act should be observed with due care.

Doubtful borderline cases are often referred to the legal staff for a ruling. The question of training navigators for service at sea or in the air has been discussed by the Regional Advisers, the National Advisory Committee, and finally referred to the legal counsel of the Federal Security Agency. Excerpts from this opinion were sent to the institutions. The opinion does not support our giving courses in navi-

gation for deck officers or airplane pilots under the act appropriating funds for the ESMWT program.

On the other hand, a course in navigation requested for engineers in the Engineers' Corps of the Army has been considered acceptable. Likewise, courses in sanitation may be given for engineers but not for health officers. The act authorizes us to approve courses that are needed for the training of engineers, chemists, physicists and production supervisors, but this authorization does not include the same courses for persons engaged in other activities.

Courses to train teachers for teaching in this program have never been questioned, but the legality of courses in mathematics and physics for high-school teachers was not clear and no steps were taken in this direction until a legal ruling in their favor had been obtained. This favorable ruling was based upon the need for this training to meet teacher shortages which would affect adversely the qualifications of high-school graduates to take courses in engineering and physics. During the past summer, such courses were approved as an aid in providing high-school students with the foundation necessary for engineering training and thus being a step towards meeting the shortage of engineers. These courses will be continued on a part-time basis to upgrade high-school teachers where institutions find it feasible.

For high-school teachers in the more remote areas where the need is most acute, the correspondence method of instruction has been adopted after some study. This correspondence method will be limited to one standard course in physics and one in mathematics. The outlines and lesson materials for these are being prepared by a committee of experienced correspondence method teachers, headed by Dean F. O. Holt, of the University of Wisconsin. The courses will be made conveniently available to all sections of the country through about 20 institutions with long experience in conducting correspondence courses.

These borderline cases have been mentioned to indicate the type of questions that must be answered one way or the other. The institutions have accepted in a cooperative spirit the decisions that were reached, even though they may have had difficulty in agreeing with some of them.

There have been newspaper reports of overhead reorganizations in Washington affecting this program, and many here present may have questions whether this will affect the program. So far, no direct effect on the working of the program has been apparent.

This program operates in the Office of Education through powers and responsibilities delegated to the director by the commissioner of education. The Office of Education until recently has been entirely within the Federal Security Agency, of which Paul V. McNutt is the administrator. A recent order by the President transferred the functions relating to war training in the Office of Education from the Federal Security Agency to the War Manpower Commission, of which Mr. McNutt is chairman. The effect of this order is to change the organization under which the program operates. In the War Manpower Commission, President Edward C. Elliott, of Purdue University, as the chief of the Professional and Technical Personnel Division, has general direction of this program as well as that of the National Roster of Scientific Personnel, and the Procurement and Assignment Service for Physicians, Dentists and Veterinarians.

The War Manpower Commission operates many designated activities through 12 regional directors who have authority throughout their regions. These designated activities include the training programs below college level, but not the college-level training.

In general, then, it appears that so long as Dr. Elliott is satisfied with the conduct of the program, and so long as the War Manpower Commission system of regional directors is not imposed on this program, this change in overhead organization will not materially affect the conduct of the program.

In conclusion, it is hoped that this progress report has been of interest and that it will be of assistance to the colleges in answering the question proposed as the topic of this paper.

OBITUARY

HARRISON ESTELL HOWE

HARRISON ESTELL HOWE, editor of *Industrial and Engineering Chemistry,* died from a heart ailment, at his Washington home on December 10, 1942. He was sixty years old and had been editor of the publication for twenty-one years. His demise brought to a close a remarkable life devoted to the service of the chemical profession. Under his editorship *Industrial and Engineering Chemistry* rose to the foremost publication in its field and exerted great influence during the years of rapid expansion of industrial chemistry.

Dr. Howe was born in Georgetown, Ky., in 1881, a son of William James and Mary (Scott) Howe. He was educated at Earlham College, Richmond, Ind., where he received a B.S. degree in 1901. He did post-graduate work in chemistry at the University of Michigan and at the University of Rochester, receiving the M.S. degree from the latter institution in 1913.

What was to be a long and profitable association with chemical industry began for Dr. Howe in 1902 when he became chemist for the Sanilac Sugar Refin-

ing Company in Croswell, Michigan. In 1904 he joined the staff of Bausch and Lomb Optical Company, Rochester, N. Y., where he was in turn chemist, office manager, and editor. He married, in 1905, Miss May McCaren. He joined Arthur D. Little, Inc., and Arthur D. Little, Ltd., in Boston and Montreal. In 1916–17 he was chemical engineer and assistant to the president of the Canadian branch of the Little firm. During World War I, Dr. Howe was consultant to the Nitrate Division of Army Ordnance.

In 1919 he became chairman of the Division of Research Extension of the National Research Council during which term he raised a considerable portion of the money necessary to build and furnish the Marine Biological Laboratories at Woods Hole, Mass., one of the largest and most important laboratories in the country devoted to study of ocean life. This position he terminated in 1921 when he assumed the editorship of *Industrial and Engineering Chemistry,* his title and position at the time of his death.

During his busy life, Dr. Howe's services to the chemical profession were recognized in many ways. Honorary degrees were conferred upon him by the University of Rochester, Sc.D. (1927); Southern College, LL.D. (1934); Rose Polytechnic Institute, Eng.D. (1936); South Dakota State School of Mines, D.Chem. (1939). Decorated in 1926 by Italy as an Officer of the Crown, Dr. Howe also received another outstanding honor on November 6, 1942, when the American Section of the Society of Chemical Industry awarded him the Chemical Industry Medal. This honor is granted yearly to outstanding scientists responsible for the application of research to industrial processes. He was also a fellow of the American Association for the Advancement of Science.

In 1922, Dr. Howe was chairman of the committee on work periods of the American Engineering Council of the Federated Engineering Societies, and he took a leading part in reducing the hours of labor in industry. A survey made by his committee showed that the tendency throughout the world was toward the eight-hour day and abolition of the prevalent twelve-hour day.

He was a trustee of Science Service and a member of the Purdue Research Foundation. Strongly in favor of scientists sharing in the wealth created through their discoveries, Dr. Howe was an advocate of action for devising a plan under which the legitimate claims of scientists to remuneration could be recognized. He was a member of the advisory board of the Lalor Foundation and general conference leader in the Institute of Politics, Williamstown, Mass., in 1926–29.

Dr. Howe was a colonel in the Chemical Warfare Reserve of the U. S. Army and a member of the A.C.S. advisory committee to that service. He was chairman of the Chemicals Group of the Chemical Priorities Committee of the Office of Production Management. Later he became chairman of the advisory committee of the Chemical Section of the War Production Board.

A member of many organizations, Dr. Howe brought to all of them his enormous capacity for work. He served two terms as director of the American Institute of Chemical Engineers and was their representative for ten years on the American Engineering Council of which he was treasurer for eight years. His work for the American Chemical Society, in addition to his editorship, entailed many committees and responsibilities too numerous to list. Suffice to say that he always had time to advise and labor in his chosen field and to him chemistry paid tribute by continually asking for his helping hand. His clubs included, among others, the Cosmos Club, the Torch Club and the Chemists' Club.

He had a deep and abiding interest in Rotary International. Their unselfish aims and desires for service to mankind appealed to him and gave him still another opportunity to serve. He was president of the Washington, D. C., club, governor of the 34th district, member of its magazine committee, and a director in 1936–37.

Throughout his life, Dr. Howe had been constantly in touch with the application of science, particularly in chemistry, to the problems of everyday life. He wrote and edited many volumes for the public, and among his works are "The New Stone Age"; "Profitable Science in Industry"; "Chemistry in the World's Work"; "Chemistry in the Home" and a series of six Nature and Science Readers for School Children (with E. M. Patch). He edited two volumes of chemistry in industry, 1924–25, prepared especially for use in connection with the American Chemical Society Prize Essay Contest. He was also author of numerous articles in scientific and lay publications.

Each activity and interest of Dr. Howe's was investigated and worked with remarkable thoroughness. He became one of the best public speakers on chemistry in the United States. No one hearing him speak about the many wonders he brought up from his "magic grab bag" will soon forget the intensely interesting and lucid comments which accompanied each showing. His principal hobbies were gardening and photography and to each he gave his full energies. Thus at his homes in Washington and Woods Hole, he grew many prize winning flowers and planned gardens extensive and excellent. He had an enormous collection of colored transparencies and motion pictures which were remarkable for their variety. He practiced scientific farming at his farm in Richmond, Indiana.

Dr. Howe is survived by his wife, Mrs. May McCaren Howe, two daughters, Mrs. Oscar A. Provost, Mrs. Frank B. Clinton, five grandchildren, and a sister, Mrs. Jeanette Wilson.

American chemistry has lost an outstanding figure in the death of Harrison Estell Howe. His abilities and willingness to apply them for the good of mankind are attributes too seldom found. His passing is sorely mourned.

F. J. VAN ANTWERPEN

RECENT DEATHS

DR. CLINTON H. CURRIER, who retired in 1938 as associate professor of mathematics and astronomy at Brown University, died on January 5, at the age of sixty-seven years.

DR. MAX MELTSNER, associate professor of chemistry at the College of the City of New York, died on January 16. He was in his fifty-seventh year.

DR. SUSAN P. NICHOLS, professor emeritus of botany of Oberlin College since 1939, after having been a member of the faculty for 31 years, from 1933 to 1938 head of the department, died on December 7, at the age of sixty-nine years.

ARTHUR H. NORTON, curator of the Portland, Maine, Society of Natural History, died on January 5, at the age of seventy-two years.

CHARLES H. WARD, president of the Anatomical Laboratory of Charles H. Ward at Rochester, N. Y., died on January 18, at the age of eighty years.

SIR WILLIAM ARBUTHNOT LANE, the British surgeon, died on January 16, at the age of eighty-six years.

SCIENTIFIC EVENTS

JOINT COUNCIL OF SCIENTIFIC MEN IN GREAT BRITAIN

Nature states that a Joint Council of Professional Scientists, representing more than ten thousand qualified men of science, has been set up in Great Britain under the chairmanship of Sir Robert Pickard by the Institutes of Chemistry and Physics in association with representatives of professional botanists, geologists, mathematicians and zoologists. The council has been established to voice the collective opinion of scientific men on matters of public interest, to provide a liaison between professional organizations of scientific men for coordinated action in matters of common interest, and in particular to concern itself with (1) the utilization of men of science to the best advantage in the service of the community; (2) the education, training, supply and employment of scientific workers; (3) the better understanding of the place of men of science in the community; (4) the maintenance of adequate qualifications and ethical standards among professional men of science; (5) the supply of information and advice to public and other bodies on matters affecting men of science.

The members of the council are as follows: *Institute of Chemistry:* Dr. J. J. Fox, Professor Alexander Findlay, Dr. G. Roche Lynch, Sir Robert Pickard, Dr. H. A. Tempany, R. B. Pilcher; *Institute of Physics:* Sir Lawrence Bragg, Professor J. A. Crowther, E. R. Davies, Dr. B. A. Keen, Dr. H. Lowery, Dr. H. R. Lang; *Representing Botanists:* Professor W. Brown; *Representing Zoologists:* Professor D. Keilin; *Representing Mathematicians:* Professor S. Chapman; *Representing Geologists:* Professor H. H. Read. The joint council has been established for the period of the national emergency, but it may form the nucleus of some more permanent organization to facilitate the close collaboration between professional men and women practising in all branches of science. Communications to the council should be addressed to Dr. H. R. Lang, Honorary Secretary, Joint Council of Professional Scientists, care of Institute of Physics, at its temporary address, The University, Reading, Berks.

COMMITTEE ON SANITARY ENGINEERING OF THE NATIONAL RESEARCH COUNCIL[1]

A SANITARY engineering committee has been organized, at the request of the Surgeon General of the Army, by the National Research Council through the Division of Medical Sciences acting for the Committee on Medical Research of the Office of Scientific Research and Development. Through liaison officers, advice and assistance on sanitary engineering problems are also furnished to the Navy and the Public Health Service.

As epidemiologic and entomologic advice was deemed necessary, personnel representing these sciences was included. Close liaison with the Surgeon General's Office is maintained through the Sanitary Engineering Branch of the Division of Preventive Medicine. The committee consists of:

Abel Wolman, *chairman,* professor of sanitary engineering at the Johns Hopkins University.

Kenneth F. Maxcy, *secretary,* professor of epidemiology

[1] The *Journal* of the American Medical Association.

at the School of Hygiene and Public Health, the Johns Hopkins University.

Harold E. Babbitt, professor of sanitary engineering at the University of Illinois.

F. C. Bishopp, assistant chief of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

V. M. Ehlers, chief engineer of the Texas State Board of Health, Austin.

Gordon M. Fair, professor of sanitary engineering at Harvard University.

H. A. Whittaker, chief engineer of the division of sanitation, State Department of Health, Minneapolis.

In the several meetings to date, the committee has devoted major efforts to the problem of procurement and training of the large number of sanitary engineering personnel required for essential war activities. In addition to the needs for sanitary engineers as commissioned officers in the Sanitary Corps of the Army, the U. S. Public Health Service and the Corps of Engineers utilize sanitary engineers on a civil service status.

The committee has also considered the sanitary engineering functions performed by the Sanitary Corps of the Army with a view toward providing constructive suggestions on the many problems occasioned by the war, including the safeguarding of army water supplies, the disposal of waste and malaria control.

The program covering future activities of the committee includes a continuation of its present work on the availability of and the demand for sanitary engineering personnel, the orderly procurement of and assignment to military, semi-military and civilian agencies of trained sanitary engineers, information on military sanitary engineering problems and their solution and a consideration of postwar needs for sanitary engineers and the fields in which they may be most profitably utilized.

The committee has had strong liaison representation from the War Department by the presence in the deliberations of Colonels Simmons, Hardenbergh, Prentiss and Robinson; from the Navy by Admiral Stephenson and Commanders Cushing, Tipton and Burton; from the U. S. Public Health Service by J. K. Hoskins, and from the Selective Service in the person of Major Robert A. Bier. The National Research Council representatives in the deliberations have been Drs. Weed, Davison and Forbes and Colonel Larkey.

PRESENTATION OF THE MELCHETT MEDAL

As already noted in SCIENCE the Melchett Medal, awarded annually by the Institute of Fuel, England, for outstanding achievement in work involving the scientific preparation or use of fuel, was presented this year to Arno C. Fieldner, chief of the Fuels and Explosives Service, U. S. Bureau of Mines. Dr. Fieldner was the second American to be so honored.

Chemical and Engineering News gives the following account of the presentation:

Because Dr. Fieldner was unable to go to England to receive the medal, he gave his lecture, "The Analysis and Testing of Coal in Relation to Its Properties and Utilization," in the Bureau of Mines sound-film studio in Pittsburgh, Pa., where it was recorded on a 16-mm film. The film was sent to England and by this means Dr. Fieldner was able to deliver *in absentia* the Melchett Memorial Lecture at the opening meeting of the institute on October 13, 1942. The medal was received formally at this time by a member of the American Embassy, who in turn transmitted it to the American Society of Mechanical Engineers, and it was formally presented to Dr. Fieldner at the annual banquet of that society in New York on December 3, 1942. The presentation was made by Arthur Selvey, son of the president of the Institute of Fuel, who is an engineer with the Detroit Edison Company.

This unique procedure was received with enthusiasm by the members of the Institute of Fuels, who were given an introduction to the author by photographic proxy while listening to an address of considerable interest, and who appreciated the care with which the film had been prepared.

AWARDS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

AT the ninetieth meeting of the American Society of Civil Engineers, which was held in New York City on January 20 and 21, the following honors were conferred:

The Norman Medal to Karl Terzaghi, lecturer, Harvard University, for paper entitled "General Wedge Theory of Earth Pressure."

The J. James R. Croes Medal to Charles F. Ruff, sanitary engineer, Caribbean Architect-Engineer, New York, N. Y., for paper entitled "Maximum Probable Floods on Pennsylvania Streams."

The Thomas Fitch Rowland prize to Shortridge Hardesty, consulting engineer, Waddell and Hardesty, New York, N. Y., and Alfred Hedefine, associate engineer, Waddell and Hardesty, New York, N. Y., for paper entitled "Superstructure of Theme Building of New York World's Fair."

The James Laurie Prize to W. Watters Pagon, consulting engineer, Baltimore, for paper entitled "Transatlantic Seaplane Base, Baltimore, Maryland."

The Arthur M. Wellington Prize to William J. Wilgus, Ascutney, Vt., for paper entitled "The Grand Central Terminal in Perspective."

The Collingwood Prize for Juniors to John F. Curtin, senior civil engineer, the Texas Company, New York, N. Y., for paper entitled "Bridge and Tunnel Approaches."

The Rudolph Hering Medal to Robert T. Regester, consulting engineer, Baltimore, for paper entitled "Problems and Trends in Activated Sludge Practice."

The Construction Engineering Prize to Rear-Admiral Frederic R. Harris, U.S. Navy (retired), consulting en-

gineer, New York, N. Y., for paper appearing in June, 1942, issue of *Civil Engineering* entitled "Evolution of Tremie-Placed Concrete Dry Docks."

The Daniel W. Mead Prize to Alfred C. Ingersoll, research engineer, The Linde Air Products Company, Tonawanda, N. Y., for the best paper submitted by a student on "Ethical Standards and How Best They Can Be Developed."

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

THE national technical meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building from January 25 to 29.

According to a statement made by Floyd A. Lewis, acting editor of *Electrical Engineering,* emphasis at this year's meeting will be on war problems. Several of the technical sessions and conferences will concern conservation of critical materials through more efficient utilization of such materials as are used on electrical systems. In addition to the twenty-one technical sessions, sub-sessions and conferences, there will be a general session on Wednesday morning, January 27, devoted to engineering man power in the war effort. Also at this session, which will be presided over by the president of the institute, H. S. Osborne of New York, the Alfred Noble Prize will be presented to George W. Dunlap.

Another feature of the meeting will be the presentation of three engineering awards at a special session held on Thursday evening. The Edison Medal, highest award of the institute, will be presented to Major Edwin H. Armstrong, professor of electrical engineering, Columbia University, who has contributed so much to radio. The John Fritz Medal, awarded jointly by a group of national engineering societies including the institute, will be presented to Dr. Willis R. Whitney, vice-president in charge of research of the General Electric Company, Schenectady, N. Y. The Hoover Medal, also a joint award, will be presented to Dr. Gerard Swope, president of the General Electric Company, New York, N. Y. Following the medal-presentation ceremonies, Dr. George C. Southworth, of the Bell Telephone Laboratories, will deliver an address entitled "Ultrahigh Frequencies." This should be of especial interest in view of the wide application of ultrahigh frequencies or so-called "microwaves," in the present war.

The American Institute of Electrical Engineers has the largest membership of any of the leading national engineering societies, numbering 19,916; there are 72 local sections in major North American cities, and 124 student branches in engineering schools. The winter national technical meeting is one of three national and several regional meetings held each year for the purpose of reviewing and discussing important technical and related developments. Emphasis at all these meetings for the current year is on war problems. Registered attendance at recent winter meetings has exceeded 1,600, and there is every reason to believe that the attendance this year will be up to its usual standard.

CANCELLATION OF THE ANNUAL MEETING OF THE AMERICAN PHYSIOLOGICAL SOCIETY

THE American Physiological Society has issued the following statement:

> For the first time in the history of our society it has seemed wise to cancel the annual meeting. Action in this direction was first taken by the executive committee of the federation, which voted 11 to 2 in favor of cancellation of the meeting of the federation to be held in Cleveland from April 6 to 10. On referring this matter to the individual councils of the several societies, the action was ratified by a majority of each of the separate councils. Our own council further voted (5 to 2) not to hold an annual meeting independently of the federation.
>
> The chief reasons given for this decision were (1) the difficulty of transportation and the request by Mr. Eastman, Coordinator of Defense Transportation, "that conventions should not be held unless they are related to the war effort." (2) The advice of the Science Advisory Committee of the National Resources Planning Board "that meetings not closely connected with the war effort should be postponed" and the suggestion "that some large associations may find it advantageous to organize their annual meeting in regional gatherings rather than in a single meeting in one place." (3) The difficulty of making our meeting a material contribution to the war effort because of (a) confidential nature of much if not most of the research work being carried on by our members, (b) preoccupation of potential speakers with other more essential war work, and (c) added teaching burdens in all our laboratories.

SCIENTIFIC NOTES AND NEWS

DR. PERRIN H. LONG, professor of preventive medicine at the Johns Hopkins Medical School, has received the award of the Southern Medical Association for original work by one of its members. The award was made in recognition of his studies on the sulfonamides.

THE Octave Chanute Award of the Institute of Aeronautical Sciences has been made to A. Lewis MacClain, aircraft engine test pilot and engineer of the Pratt and Whitney Aircraft Division, of the United Aircraft Corporation, East Hartford, Conn., in recognition of the development of the engine torque

indicator, which measures brake horsepower, a practical device for accurately measuring the power output of a plane engine during flight. Presentation of the award will be made at the honors night dinner of the institute on January 26.

DR. JOHN R. MOHLER, chief of the United States Bureau of Animal Industry, was the recipient of an alumni award of merit at the Founders Day ceremonies on January 16 of the University of Pennsylvania.

DR. DONALD D. VAN SLYKE, member of the Rockefeller Institute for Medical Research, New York, has been elected an honorary member of the British Physiological Society.

DR. R. G. HOSKINS, of the Harvard Medical School, has been elected an honorary member of the Asociación Médica Argentina.

DR. JOHN R. LEWIS, professor of chemistry in the University of Utah, has become professor and head of the department of metallurgy. Dr. Lloyd E. Malm, associate professor of chemistry in the Utah State Agricultural College, at Logan, has been appointed associate professor of chemistry at the university.

THE *Journal* of the American Medical Association reports that Dr. Evelyn B. Tilden, of the Rockefeller Institute for Medical Research, has been appointed associate professor of bacteriology at the Medical School of Northwestern University.

OFFICERS of the Genetics Society of America elected for the year 1943 are: Professor Marcus M. Rhoades, Columbia University, *President;* and Professor G. W. Beadle, Stanford University, *Vice-president.* The executive committee for 1943 is composed of these two officers together with Professor Th. Dobzhansky, Columbia University, and Professor E. W. Lindstrom, Iowa State College, presidents for 1941 and 1942, and Dr. B. P. Kaufmann, Carnegie Institution, Cold Spring Harbor, N. Y., *Secretary-treasurer.*

AT the meeting of the Rittenhouse Astronomical Society on January 8, Armand N. Spitz was installed as president. Dr. Charles P. Olivier, director of the Flower and Cook Observatories of the University of Pennsylvania, delivered the address of the retiring president. His subject was "Observational Practice for Variable Stars."

AT the seventy-fourth annual meeting on January 11 of the Board of Trustees of the American Museum of Natural History, Colonel F. Trubee Davison was reelected president of the museum. Other reelections were A. Perry Osborn, *First vice-president;* Cleveland E. Dodge, *Second vice-president;* E. Roland Harriman, *Treasurer,* and Clarence L. Hay, *Secretary.* Colonel Davison is on active military service, and Mr. Osborn will continue as acting president. It was announced at the meeting that after the war the museum building at Central Park West and 79th Street will be modernized completely, both externally and internally.

THE Board of Trustees of the Carnegie Institution of Washington at their recent annual meeting elected Henning W. Prentis, Jr., president of the Armstrong Cork Company, Lancaster, Pa., a member of the board to fill the vacancy created by the death of Dr. Stewart Paton.

DR. EDWARD DAVENS, Baltimore, pediatric consultant to the Maryland State Department of Health, has been appointed chief of the Bureau of Child Hygiene to succeed Dr. James H. M. Knox. The appointment will take effect on September 1.

DR. J. S. SWEARINGEN, professor of chemical engineering at the University of Texas, has leave of absence to join the Office of Scientific Research and Development.

PROFESSOR EMERITUS W. W. CHARTERS, of the Ohio State University, formerly director of the Bureau of Educational Research, has become chief of the training division of the War Manpower Commission.

AUSTIN W. CURTIS, JR., for eight years assistant to the late Dr. George Washington Carver, of the Tuskegee Institute, has been appointed his successor.

SIR JOHN C. G. LEDINGHAM, F.R.S., will retire on March 31 from the post of director of the Lister Institute of Preventive Medicine, London, which he has held since 1930. His successor will be Dr. A. N. Drury, F.R.S., Huddersfield lecturer in special pathology at the University of Cambridge, a member of the scientific staff of the Medical Research Council.

THOMAS E. MILLIMAN has resigned as chief of the agricultural-chemicals unit of the War Production Board and is returning to the Grange League Federation Exchange. His headquarters will be at Ithaca, N. Y., where he will be in charge of fertilizers and agricultural chemicals. Dale C. Keiffer, of Bethesda, Md., has been named acting chief of the unit.

DR. JOHN S. KARLING, professor of botany at Columbia University, a former director of the chicle research work of the Tropical Plant Research Foundation, has been granted leave of absence for the duration of the war to become botanical specialist in latex-bearing plants for the Department of Rubber Exploration of the American Republics Aviation. He will be associated with Dr. G. H. H. Tate, formerly of the American Museum of Natural History, in exploring the little known tributaries of the Tapajoz and Madeira Rivers in Brazil for untapped sources of wild rubber.

CLINTON G. ABBOTT, director of the Natural History Museum, San Diego, Calif., has been made a member of a Guayule Committee for the region of San Diego, to investigate possibilities of guayule cultivation, seed-collecting, planting, harvesting and suitable acreages.

DR. G. H. PARKER, Harvard University, lectured before the Royal Canadian Institute, Toronto, on January 9, on "The Coloration of Animals and their Ability to Change their Tints." He also spoke before the department of zoology of the University of Toronto "On the Cultivation of the Research Spirit."

DR. HOMER W. SMITH, professor of physiology and director of the Physiological Laboratories of the New York University College of Medicine, gave the William Henry Welch Lectures of the Mount Sinai Hospital of New York on January 5 and 12. He spoke on "The Physiology of the Kidney."

SIR STAFFORD CRIPPS, Julian Huxley and R. A. Watson-Watt will participate this week in a trans-atlantic short-wave discussion with Americans on the "Answering You" program of the British Broadcasting Corporation. The Americans, consisting of Watson Davis, Gerald Wendt and Samuel Kaiser, will question the British on the contributions of science to the war effort. The program may be heard over WNYC in New York on Sunday, January 24, at 5:30 P.M., and elsewhere over the Mutual network.

THE forty-fifth annual meeting of the Washington Academy of Science was held on January 21. Following the annual meeting, there was held the three hundred and sixteenth meeting of the academy with the following program: "Reports on Governmental Publication of Scientific Research" by Atherton Seidell, for the U. S. Public Health Service; by Melvin C. Merrill, for the U. S. Department of Agriculture, and by Kasson S. Gibson, for the National Bureau of Standards. "The Censorship of Scientific Publications Going Abroad" was described by Edward D. Hill, of the U. S. Board of Economic Warfare.

THE meetings of the Association for the Study of Internal Secretions, tentatively scheduled to be held in Cleveland, Ohio, on April 5 and 6, have been indefinitely postponed.

IN order to stimulate the investigation of cyclic phenomena the Foundation for the Study of Cycles, 400 West 118th St., New York, N. Y., will award a medal for the best work published on that subject in any field of science during 1943. The judges who will award the medal are: Dr. C. G. Abbot, secretary of the Smithsonian Institution, Washington, D. C.; Dr. Harold E. Anthony, dean of the scientific staff, American Museum of Natural History, New York; Professor W. C. Mitchell, Columbia University, director of the National Bureau of Economic Research; Professor V. C. Wynne-Edwards, biologist, McGill University, and Professor Ellsworth Huntington, geographer, Yale University, *chairman.*

APPLICATIONS to the Committee for Research in Problems of Sex of the National Research Council, for financial aid during the fiscal year beginning on July 1, in support of work on fundamental problems of sex and reproduction, should be received before April 1. They may be addressed to the Chairman, Dr. Robert M. Yerkes, Yale School of Medicine, New Haven, Conn. Although hormonal investigations continue to command the interest and support of the committee, preference, in accordance with current policy, will ordinarily be given to proposals for the investigation of neurological, psychobiological and behavioral problems of sex and reproduction.

COLUMBIA UNIVERSITY has announced gifts amounting to over $200,000. Among these the Josiah Macy Jr. Foundation contributed $150,000, to support a program of research and teaching in tropical medicine at the Medical Center over a five-year period. The Lillia Babbitt Hyde Foundation gave $20,000 to the radiological research laboratory, and Schering and Glatz, Inc., $10,000 for research projects in the department of bacteriology.

ANNOUNCEMENT is made of the establishment by the Gulf Oil Corporation of a fellowship in geology at the University of Chicago. The first award of this fellowship will be made for the school year 1943–44, provided qualified candidates are available under war conditions. The stipend will approximate $1,200 a year, the Gulf Corporation contributing $900 and the university making available additional funds or allowances equivalent to the tuition requirements, namely, $300. The initial award will be in the field of sedimentation, and candidates must have had the equivalent of at least a year of graduate work in geology at an institution of recognized standing. The fellowship holder will be expected to devote part of his time to research in sedimentation. The fellowship may be renewed on recommendation of the department. Renewal at the end of nine months, rather than at the end of a twelve-month period is possible if the fellow works under an accelerated program. Application forms may be obtained from the Department of Geology, University of Chicago, and must be returned to the university before March 1. The award will be announced on April 1.

A FOUR-TERM program in forestry, which could be completed in a year and three months under the accelerated program now in effect, is being planned by the School of Forestry and Conservation of the University of Michigan, of which Samuel T. Dana is

dean. Both the War Manpower Commission and Selective Service headquarters have recognized forestry, lumbering and logging as essential activities, and the new program is designed to train men for effective work in those branches of industry in which forestry and forest products are involved. Another objective is to train men so that they may qualify as officer material as quickly as possible after entering the armed forces, especially in forest regiments, engineering units, field artillery and infantry.

DISCUSSION

AGAR-BEARING SEAWEEDS AT LA JOLLA, CALIFORNIA[1]

THE use of red seaweeds as a source of jellies began and developed in the Far East. Nine tenths of the world's agar is produced in Japan by a purely cottage industry, while on the shores of China, Malaya, the East Indies and Ceylon, there is manufactured by native methods a jelly which, if dried, would be the agar of commerce. Of about thirty species of red algae which are recorded as agariferous, only four are used outside of the regions named. It is possible that on the southern and eastern shores of Asia all profitable sources of agar have already been found, but on the other coasts of the world there probably exist considerable resources of this kind which have never been developed. The prospect of competition with cheap Japanese agar has prevented large-scale investment in exploratory and developmental processes. In Russia, with government protection, there is a modern agar industry of less than ten years' standing, utilizing two species of seaweeds, *Ahnfeltia plicata* on the Maritime coast and in the White Sea and *Phyllophora rubens* in the Black Sea. In this country, repeated efforts during the last twenty years have finally established a modern manufacture utilizing *Gelidium cartilagineum* and *Gracilaria confervoides* collected on the coasts of southern California and Lower California.

With Oriental supplies of agar cut off, attention in this country has been turned to agar substitutes and the reclamation of agar, as recent notes in this journal testify. Believing with Humm[2] that, in addition, considerable domestic resources exist, both as unlocated beds of *Gelidium* and *Gracilaria* and as beds of red algae whose agar-producing potentialities have never been recognized, the authors have examined and tested several red algae growing at La Jolla in harvestable quantities. Restrictions on the use of boats at sea have delayed the extensive survey which the situation demands and limited us to collecting at low tide and by swimming and diving in shallow water. About two miles of exposed rocky shoreline have been covered and considerable quantities of agariferous seaweeds located.

The seaweeds were drained and weighed, freed of sand, shells and conspicuous contaminating species while being washed in tap water, dried in the sun and weighed again. Bleaching was not attempted. Fifty gram lots of dried material were weighed out and soaked in tap water for twenty-four hours except where otherwise noted. Each lot was drained and put into one liter of tap water. Sulfuric acid or sodium hydroxide was added to adjust the solution to pH 6.0, 8.0, 10.0 or 12.0, except as otherwise noted and the material cooked for twenty-four hours in a water bath. Distilled water was added periodically to replace evaporation losses. Every two hours a 25 ml sample was removed and cooled to 23°–25°. The strength of the jelly (if a jelly was formed) was measured with a Lipowitz meter as described by Kizevetter[3] in which a segment of a sphere of stated dimensions is driven through the surface of the jelly by weights. The pH was measured and, when necessary, acid or alkali was added to the parent lot to maintain the pH at the value fixed on initially. The cooled sample was stirred back into the parent lot. At the end of the single extraction a 100 gram sample was filtered through two layers of cheesecloth, cooled, frozen, chopped, thawed at room temperature, drained and air dried on a glass plate. The dried agar was weighed, and a 1 per cent. jelly was made from part of it for a strength test.

Six species were readily collected in sufficient quantities to test. *Gelidium cartilagineum* grows below the low tide mark and is collected commercially by divers working as deep as ten fathoms. However, fronds 50–75 cm long can be collected in quantity just below lower low tide. *Pterocladia sp.* grows low in the intertidal zone, the 12–18 cm fronds thickly covering exposed rocks. *Endocladia muricata,* 5–8 cm long, grows higher in the same zone. *Gigartina canaliculata,* with fronds 10–12 cm in length, also occurs in the intertidal zone. *Gigartina serrata* with fronds 20–30 cm. long grows below low tide, very densely in partially shaded places. *Gigartina asperifolia* was the only species collected which so far seems unsuitable as an agar source.

A year-round study will be necessary to establish the amounts of these seaweeds which, on the average, can be collected in a day, week or month and the annual harvest which can be expected from a section of coastline. In summer, with a calm sea, approximately 100 to 300 pounds of wet seaweed of any of the species named can be collected at one tide by our

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 187.

[2] H. J. Humm, SCIENCE, 96: 230–231, 1942.

[3] I. V. Kizevetter, *Bull. Pac. Sci. Inst. Fisheries and Oceanography (Russian)*, 13: 1–135, 1937.

methods. The dry weight varies from 17 to 25 per cent. of the wet weight. The species growing near or below low tide are large and can be collected rapidly but only for a short time each day, while the species of the intertidal zone take more time to collect, but more time is available.

The yield of agar from *G. cartilagineum* was twice as great at pH 6.0 and pH 8.0 as at pH 10.0 and pH 12.0. In the case of one lot no acid or alkali was added and it maintained itself at pH 8.6 during the cooking. At pH 6.0 and pH 8.0 the strength of the jelly increased steadily during the first eighteen hours and afterwards remained unchanged until cooking was stopped after twenty-seven hours. This experience corresponds with the traditional Japanese method which includes the addition of a little vinegar to the cooking water and with the American commercial method in which no attempt is made to control the acidity.

The yield from *Pterocladia* was greatest at pH 6.0, but there was little difference between all lots except the lot at pH 10.0 which showed a very small yield. At pH 6.0 the maximum jelly strength was reached after fourteen hours cooking, after which a 20 per cent. decrease occurred. The greatest yield would probably have been obtained by stopping the extraction at pH 6.0 at the end of fourteen hours.

The yield of agar from *Endocladia muricata* was nearly twice as great at pH 12.0 as in any other lot. The maximum jelly strength was reached after fourteen hours' cooking and remained constant until cooking stopped. The yield of dry matter from *E. muricata* was about twice as great as from *G. cartilagineum* and from *Pterocladia*. However, the firmness of a 1 per cent. jelly was only half as great. Either *Endocladia* agar has a low jellying power or the crude dry extract contains considerable impurities.

None of the three species of *Gigartina* tested yielded a jelly after fourteen hours cooking at pH 6.0, 8.0, 10.0 or 12.0. In a second experiment, the alkalinity of the different lots was maintained by cooking in tenth molar calcium chloride, with excess calcium carbonate, or with excess calcium hydroxide, respectively. Under these conditions *Gig. canaliculata* at pH 12.0 (excess calcium hydroxide) yielded a soft jelly. Following the method described by Kizevetter[3] for the treatment of *Ahnfeltia plicata,* dried seaweed of each of the three species was soaked for three days either (a) in cold saturated calcium hydroxide or (b) in cold 2 per cent. calcium chloride. *Gig. asperifolia* was so badly disintegrated by these treatments that it could not be handled. The other two species yielded firm jellies after two to five hours' cooking either in 2 per cent. calcium chloride or in saturated calcium hydroxide. Under these conditions, the two species of *Gigartina* act like *Gracilaria* in yielding their agar readily.

The most important information obtained is that out of five species of red algae not previously considered agariferous, harvestable in moderate quantity at La Jolla without special equipment, four readily yielded agar, in quantity and quality equal to that obtained from red algae at present commercially exploited.

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EARLY MASTERY OF THE GROUP CONCEPT

ONE of the most interesting facts in the history of group theory is that those who are now commonly regarded as having been the most influential in extending the use of this theory are not also those who first mastered the concept of a group. Among the former Sophus Lie (1842–1899), Felix Klein (1849–1925) and Henri Poincaré (1854–1912) are widely regarded as the most eminent, while the latter are represented by Arthur Cayley (1821–1895), Leopold Kronecker (1823–1892) and Heinrich Weber (1842–1923). None of the former three seems to have ever assumed explicitly all the postulates of the concept of a group which are now commonly regarded as essential. The most fundamental omission is that the associative law must be satisfied when three or more elements of a group are combined. Such a combination has been most commonly called a multiplication, but in the recent literature it is often called an addition.

The interest in the noted omission is partly due to the fact that it exhibits the wide use in mathematics of unannounced restrictions even by some of the most eminent modern writers. It seems, therefore, questionable whether the freshmen in our colleges should be advised to pay close attention to the associative law, which was first thus named by the noted Irish mathematician, W. R. Hamilton (1805–1865), and was effectively introduced by him into the common mathematical literature. It is of great importance in abstract group theory, but the very successful use of group theory by the first three authors noted above implies that in many fields the group concept can be used successfully without restricting it by this law. At any rate, the history of group theory would not be complete without noting the comparatively late emphasis on this law in the development of this subject.

The six names mentioned in the first paragraph of this article exhibit the gradual development of the modern group concept which was practically completed by the last of these writers in the *Mathema-*

tische Annalen, volume 43 (1893). The given list of six does not include any American author, but all the writers included therein were very influential in starting work along this line in our country and some Americans, including E. V. Huntington, made further studies relating to the simplification of the postulates of the group concept. While Heinrich Weber may now be reasonably regarded as the first man who fully mastered the group concept (1893), it is of some interest to note that about three years thereafter he made an erroneous assertion relating thereto in the first edition of the second volume of his "Algebra" (1896) when he stated (page 54) that the most important example of a commutative group is the system of our natural numbers when they are combined by multiplication.

On account of the wide use of this algebra this error was often repeated by later writers and seems not to have been publicly corrected before the appearance of the second edition of this volume about three years later. It may remind one of the error committed by Sophus Lie on page 163 of volume 1 of his "Transformationsgruppen" (1888) where he asserted in effect that the numbers which are less than unity form a group when they are combined by multiplication. This error was repeated by Felix Klein several years later in the *Mathematische Annalen,* volume 43, page 66 (1893). It is, however, less striking than the one by Heinrich Weber to which we referred, since neither Sophus Lie nor Felix Klein ever definitely adopted the now common postulates of an abstract group.

Contrary to what might naturally be assumed, all the possible abstract groups of certain low orders were determined long before a satisfactory system of postulates of the group concept was published. Forward steps in the development of mathematical subjects frequently preceded the establishment of a solid foundation of the subject. The history of the development of the theory of ordinary complex numbers furnishes many instances of such forward steps. There is, however, no satisfactory evidence now extant for the assertion that "as early as the fifteenth century mathematicians were compelled to introduce symbols for the square roots of negative numbers in order to solve all quadratic and cubic equations." This assertion appears on page 92 of the valuable volume entitled "What is Mathematics?" by Richard Courant and Herbert Robbins (1941).

G. A. MILLER

UNIVERSITY OF ILLINOIS

WHEAT GRAINS WITHOUT EMBRYOS[1]

A CRITICAL examination of several thousands of wheat grains of the 1941 crop for separation of kernels only slightly affected by sprout injury showed occasional grains which had a slightly concave area where the embryo usually produces a convex area. This at once suggested the embryoless seeds described by Lyon.[2] Some of the grains were sent to Dr. George H. Conant for sectioning, and these sections show clearly the embryoless condition.

Miss Lyon was especially interested in studying the respiratory activity of such seeds because previous comparisons of activity of embryo and endosperm had been made from samples from which embryos had been removed. She did not discuss the origin of embryoless seeds. Her work was the first report of this condition in wheat. Harlan and Pope[3] had reported the first case in cereals, finding five such seeds in many thousands of barley. They suggested that either the fertilization from which the embryo is formed had failed to occur or that development had been arrested shortly afterward, since there was not more than a doubtful trace of embryo cells.

Miss Lyon found that such seeds were not infrequent in wheat, finding about 0.1 per cent. in 150,000 grains, using six different varieties representing both winter and spring wheats. The North Dakota material examined was chiefly one sample of Ceres, a hard red spring wheat developed at the North Dakota station, and the proportion was similar to that found by Miss Lyon. This adds another variety to the list and supports her conclusion that it is not an uncommon occurrence.

O. A. STEVENS

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SCIENTIFIC BOOKS

VERTEBRATE EMBRYOLOGY

Introduction to Vertebrate Embryology. By WALDO SHUMWAY. Fourth edition. 372 pp. New York: John Wiley and Sons. 1942. $4.00.

THIS text, having reached the fourth edition, has quite evidently established itself. The present issue is considerably altered, but retains the general method of comparative treatment, *i.e.,* each of the four animals, amphioxus, frog, chick and man, is compared in its development in each system or part. Physiology is also stressed as formerly. The changes relate principally to increased attention to organogeny, to de-

[1] Contribution from the N. D. Agricultural Experiment Station. Published with the approval of the director.

[2] Mildred E. Lyon, *Jour. Agr. Res.,* 36: 631–637, 1928.

[3] H. V. Harlan and M. N. Pope, *Am. Jour. Bot.,* 12: 50–53, 1925.

creased space given to genes and chromosomes, and to condensation of the material dealing with the anatomy of vertebrate embryos into an atlas. Much of the book has been rewritten, partly in an effort to include recent work. The illustrations are numerous and clear, but sometimes rough. There are nineteen chapters, including one on embryological technique, a glossary and twenty pages of index. The book is clearly the outgrowth of much use, and represents a practical adaptation of this experience.

Fundamentals of Comparative Embryology of the Vertebrates. By ALFRED F. HUETTNER. 416 pp. New York: The Macmillan Company. 1941. $4.50.

HERE is another book which has grown out of the experience of the author, more than half of the many excellent figures having come from his own hand. This is an important matter in this case, because they furnish the foundation of the entire work and are beautifully prepared. There are again nineteen chapters, but this time, after four chapters dealing with protoplasm and the cell, development of sex, chromosomes in development, gametes and fertilization, these take up in turn amphioxus, 1 chapter; frog, 3 chapters; chick, 7 chapters; and mammals, 4 chapters. There is thus quite a contrast in the general treatment, as compared with Shumway, and an evident lack of continuity in the account of the different systems. Another instance of similarity in the two books is the use of the same four animals for study.

One would expect accuracy in the treatment of general topics, such as the chromosomes, but does not always find it. Thus in discussing the process of mitosis it is stated that "Mitosis is initiated in the nucleus by the precipitation of chromatin granules and fibers which form an entangled thread-like structure called the *spireme*. . . . These are the chromosomes, their shape being constant from one cell generation to the next in spite of the fact that they disintegrate in the interphase nucleus and are built up from it again in the next mitosis." This gives a very faulty interpretation of the process, for, instead of disintegrating and reforming, they preserve their form by a continuous existence, which is the essence of their being. The number of chromosomes for Anasa is stated to be twenty-two, without indication that that is the female number. In describing the history of the X-chromosome in the grasshopper it is stated to divide in the first spermatocyte, instead of in the second. Such errors as these are unfortunate, but do not affect the general character of the book, which is excellent.

A Manual of Experimental Embryology. By VIKTOR HAMBURGER. 213 pp. University of Chicago Press. 1942. $2.50.

HERE is a book quite different from the preceding two. Its approach is experimental and it details the requirements which this method calls for, including instruments and equipment, Part I. Part II deals with experiments on amphibian embryos. Here we find a discussion of living material, including breeding habits, rates of development, culture media and rearing and feeding larvae. Under experiments there are sections devoted to technical procedures, embryonic areas, pregastrulation stages, transplantation methods, morphological fields, embryonic induction, parabiosis, external factors in development and the development of behavior patterns. Part III concerns itself with the chick embryo, and under the heading "Material and technical procedures" treats incubation, limb bud stages, equipment for operations and staining cartilage *in toto*. The experimental technique here deals with vital staining; chorio-allantoic grafts and intraembryonic transplantations. Part IV takes up regeneration experiments upon Planaria and amphibian larvae, producing the various two-headed and two-tailed larvae, tail regeneration, limb regeneration and lens regeneration effects. Finally in Part V there is a special treatment of the gradient theory of Child, with experiments on Planaria and chick embryos. For each section there is a bibliography, which deals only with the subject-matter treated. It is the opinion of the author that "a course in an experimental branch of biology not only should acquaint the student with new facts but should strengthen his power of reasoning and his logical acuity as well." The experiments outlined are all simple and do not demand any unusual apparatus or special installation. They are all routine class exercises, and none of them require the use of sections for their study. Furthermore they are so planned and stated that they may be taken up in any convenient order at the desire of the teacher. This book is sure to be a successful addition to the series of worthwhile American texts on embryology.

C. E. McCLUNG

MATHEMATICS

Calculus. By G. E. F. SHERWOOD and ANGUS E. TAYLOR. xiv + 503 pp. New York: Prentice-Hall, Inc. 1942. $3.75.

"CALCULUS" sets a new high standard for text-books for the first course in differential and integral calculus. The topics treated and the order in which they are presented are those which have become largely standard in American texts: differentiation, with the usual applications, comes first; later, integration with geometric and physical applications; finally, partial differentiation, hyperbolic functions, multiple integrals and infinite series. The unique features of the book are to be found in the treatment of the material:

fundamental concepts are emphasized; definitions, especially those of function, limit and integral, are modern and precise; more theorems are proved than usual, and the proofs given are correct.

The definition of function, which differs from that still found in many texts, and the ε, δ definition of limit are given in the first chapter. The treatment of limits distinguishes and includes limits of sequences and of functions of a continuous variable; the fundamental theorems on limits are stated and proved by ε, δ methods. The Cauchy condition is taken as fundamental in the treatment of limits of sequences; it is proved that a bounded monotonic sequence has a limit.

A correct proof is given for the formula for the derivative of a composite function (the customary proof in American text-books is simple and suggestive, but unfortunately it is not correct). It is proved that if a function has a derivative at a relative maximum or minimum, this derivative is zero (a beginning text usually bases this result on intuition). The definite integral is introduced before the indefinite; it is proved, using the Cauchy condition for the limit of a sequence, that a continuous function has a definite integral. It is stated, though not proved, that a function which is continuous on a closed interval is uniformly continuous. Duhamel's Principle is stated and proved and used systematically in setting up the integrals that occur in the geometrical and physical applications. The treatment of partial differentiation, which includes Jacobians and applications to curves and surfaces, is preceded by a chapter which gives a brief but adequate treatment of analytic geometry of three dimensions.

It may perhaps appear from this account that the book is a mathematical treatise and not a text for beginners, but such is not the case. It is undoubtedly true that the book will be most appreciated by good students, but rigor and precision have not been made stumbling blocks. Intuition has not been replaced by mathematical rigor; rather there is a happy blending of the two with each reinforcing the other. The treatment is fresh and lively; the exposition proceeds with ease and assurance.

Finally, it is in order to record the passing of the infinitesimal; the term itself does not occur in the index. The book is calculus, not infinitesimal calculus. Infinitesimals, meaning something "infinitely small," were introduced into calculus by Leibniz, and the fact that the subject was based on something mystical, unproven and lacking reality did much to hinder its early understanding and acceptance. Klein has pointed out that these "infinitely small" quantities persisted in texts even into the twentieth century in a country so mathematically advanced as Germany. Beginning with Cauchy, "infinitesimal" has more often meant something which becomes infinitely small, but even in this sense the concept has lost favor with mathematicians. At the present time calculus is based solidly on the notion of limit; at last we have a beginning text that eliminates infinitesimals entirely and enlarges the treatment of limits.

The Gist of Mathematics. By Justin H. Moore and Julio A. Mira. xii + 726 pp. New York: Prentice-Hall, Inc. 1942. Trade, $5.35; school, $4.00.

"The Gist of Mathematics" is a text-book for a survey course. There are fairly complete treatments of elementary algebra, plane geometry and solid geometry, partial accounts of plane analytic geometry and plane trigonometry, and a brief introduction to differential calculus. The book was written to teach mathematics, but the emphasis is on elementary concepts, the facts and their applications rather than on logical development and mathematical completeness. Each chapter closes with a set of exercises. Also, there are 105 pages of additional exercises and problems at the end of the book; they are grouped according to the chapters of the book, and there are precise references to relevant pages of the text. The problems will appeal to the student as modern and practical. No answers are given. Three appendices explain the method of extracting square root, list the Greek alphabet, the symbols used, mensuration formulas and facts regarding spatial relationships (plane and solid geometry theorems from the text). There is a brief set of tables in a pocket inside the back cover. A detailed index of 16 pages enhances the book's value as a reference work. The book is attractively printed; there are many figures, pen drawings, reproductions of old prints and woodcuts and photographs. The attention paid to mensuration formulas, the theorems of plane and solid geometry, and systems of weights and measures, including tables of equivalents for different systems, serve to emphasize the authors' interest in the usefulness and applications of mathematics; in the preface they refer to the needs of accountants, economists, biologists and scientific workers in all fields.

This book should be a useful text for a course in which the students have not had much previous training in mathematics, and in which the emphasis is on applications of a practical and everyday nature. The mathematics courses in a good high school cover nearly all the material in the book. Judged by standard college courses, it is elementary, all-inclusive and yet incomplete. For example, it includes six subjects, but in trigonometry the treatment of the solution of triangles is incomplete, and there is hardly any mention of trigonometric identities. Thus, it is a well-written book designed for a survey course.

Mathematics in Human Affairs. By FRANKLIN WESLEY KOKOMOOR. xi + 754 pp. New York: Prentice-Hall, Inc. 1942. Trade, \$5.35; school, \$4.00.

"MATHEMATICS IN HUMAN AFFAIRS" is undoubtedly intended as a text for a course in college mathematics which has been given with increasing frequency in recent years: a course which is cultural in nature and terminal in character—does not prepare the student for the usual trigonometry-analytic geometry-calculus sequence; the author states that it was written for "the reader of average ability with almost no previous preparation." For such a course Professor Kokomoor has written a text of unusual excellence.

"Mathematics in Human Affairs" covers practically the entire field of elementary mathematics: it begins with the simplest concepts and ends in the calculus. There are chapters on statistics, probability, mathematics of finance and geometric constructions as well as the more usual topics of algebra, trigonometry, analytic geometry and calculus. The book has the informal character of the lecture room; it is discursive and entertaining. Most of the chapters can be read independently of the others. On almost every page one finds new and interesting bits of history of mathematics, of mathematicians and of civilization in general; explanations of the origins and meanings of words; discussions of economics, philosophy and sociology; indications of the applications of mathematics; elegant solutions of certain problems not treated in the usual elementary courses; illustrative anecdotes that enliven the account; and mathematical figures, pen drawings and reproductions of old prints. It was the author's intention to show that mathematics has been one of the component parts of civilization throughout its history, and he has succeeded well.

But just because mathematics is playing such an important rôle at present in the lives of Americans, this book will probably have few readers. It can not be considered a satisfactory text for the development of those mathematical techniques needed in science, industry and the armed services (it was not intended to be such), and no young man of college age now has the leisure to study any other kind of mathematics book.

Furthermore, as a result of his decision to treat only elementary matters, Professor Kokomoor tells only part of the story of mathematics in human affairs—the part which deals with mathematics in the past: "But after all, the major portion of what we have considered is old, its age running for several centuries to several thousands of years." Mathematics is not portrayed as one of the all-important tools in the construction of the *modern* world. No stratosphere aeroplanes fly across the pages of this book, and no mention is made of the part mathematics plays in their construction and navigation.

Books on physics, chemistry, engineering and medicine for the general public contrast sharply with those on mathematics: the former tell of the wonders that are being accomplished to-day and the new world that will be built to-morrow; the latter usually tell of the subject's long and dignified past. The public, well informed about progress in other sciences, still does not know of the part applied mathematics is playing in building the new world, nor of recent brilliant results in pure mathematics such as the proof of the Ergodic Theorem, the proof of Waring's Theorem and the solution of the Problem of Plateau.

Our mathematical unpreparedness at the outbreak of the present war was one result of the public's lack of information about the subject. Although research in pure mathematics had been advancing rapidly, there were no centers for research in applied mathematics or the training of applied mathematicians for industry. Furthermore, mathematics no longer held the position of honor, nor even one of high esteem, in a liberal education; industry and the armed services were impeded because so many lacked a knowledge of even the elements of mathematics. The recent list compiled by Professor Dresden indicates to what extent America's leading position in mathematical research may have been attained by importing scholars from Europe.

The wonder books and popular expositions of science serve a useful purpose. Hermite said, "Abel has left mathematicians enough to keep them busy for five hundred years." Asked how he had accomplished so much in the six or seven years of his working life, Abel replied, "By studying the masters, not the pupils." But we are apt to overlook the sources of the initial inspiration to study the masters. Charles Darwin has recorded that Humboldt's "Personal Narrative" and Herschel's "Preliminary Discourse on the Study of Natural Philosophy," two of the leading books of popular science of his day, "stirred up in me a burning zeal to add even the most humble contribution to the noble structure of Natural Science. No one or a dozen books influenced me nearly so much as these two." Napoleon I wrote, "The advancement and perfection of mathematics are intimately connected with the prosperity of the state." Napoleon as a patron was sufficient, but in a democracy mathematics will attract able students and win support only from an informed public.

It is to be hoped that Professor Kokomoor or another will write the other volume on mathematics in human affairs—the story of the wonders of the present and the future.

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REPORTS

ABSTRACT OF A PLAN FOR COLLABORATION[1] BETWEEN COLLEGES AND UNIVERSITIES AND THE DEPARTMENT OF AGRICULTURE WITH SPECIAL REFERENCE TO TRAINING REPLACEMENTS DURING THE WAR

I. *The Problem*

THE war has made necessary many readjustments in recruiting, employing and training people for Government Service. The problem of continuing to operate effectively with fewer and less qualified personnel, and in many cases, with expanded and new agency functions, confronts every bureau and office in the department. The successful prosecution of the war and adequate maintenance of the essential functions of the Department of Agriculture depend upon trained personnel. As is the case with other agencies of Government, the department faces a serious shortage of trained workers. From the experienced personnel, the various bureaus of the department have contributed heavily to the armed forces and to other agencies. For the fiscal year 1942, the department experienced personnel separations numbering approximately 28,000 or 35.6 per cent. In contrast, for the period from 1935 through 1940, the Department of Agriculture had experienced personnel separations of about 10 per cent. each year, resulting in 6,000 to 8,000 new employees annually. How critical the shortage of personnel will become during the present emergency no one can predict.

The department normally employs large numbers of college-trained people. As of June, 1940, 41 per cent. of the employees in the department were college graduates. An additional 23 per cent. attended college, but did not graduate. Thus, approximately two thirds of the employees, as of June, 1940, had had educational experience in colleges and universities.

Work pertaining to the war effort must be done quickly and effectively, hence personnel must be recruited and trained quickly. Training is basic to the department's war strategy. And training itself must be geared to wartime conditions; it must be as up-to-the-minute as the latest airplane or gun. Some of this training can be and is being done after the new employee is on the job. However, it is recognized that pre-service training would reduce materially our recruitment and training problems and would increase the efficiency of those units having vacancies.

We are fully aware that colleges and universities already have made major readjustments to meet the war emergency. The problem before us then resolves itself into: What further can such educational institutions do, for the duration of the war, to help train personnel for positions in the Department of Agriculture.

[1] Prepared by Department Section of the Land-Grant College Department Committee on Training for Government Service, October 24, 1942.

II. *Developments Leading to Plan for Collaboration between Colleges and Universities and the Department of Agriculture*

Since 1936, the Land-Grant College Department Committee for Training for Government Service has been active in developing means of collaboration between colleges and universities and the Department of Agriculture. In recent months, the Department Committee has worked on the development of a plan for recruiting and training replacements for technical and professional positions in the Department of Agriculture during the war emergency, with special reference to the part which colleges might do. A number of bureaus of the department have been cooperating with colleges and universities for several years in training, recruiting and employing personnel. Such bureaus include Office of Experiment Stations, Forest Service, Bureau of Plant Industry, Bureau of Entomology and Plant Quarantine, Farm Security Administration, Bureau of Animal Industry, Soil Conservation Service, and Extension Service. Due to the emergency, we are now faced with the necessity of increasing emphasis on the type of training which will materially facilitate the task of getting the job done.

The committee developed the current report with the hope that maximum use may be made of the facilities of educational institutions in meeting the increasing need for trained personnel of the department during the emergency, looking forward also to the needs which will have to be met following the war.

III. *Opportunities for Collaboration between Colleges and Universities and the Department of Agriculture*

It is recognized that colleges and universities are encountering increasing difficulties with respect to losses in instructional staff. At the same time, they have been assigned additional specific responsibilities by the Army and Navy for training for the armed services. It may well be that arrangements can be made for further cooperation between the colleges and the Department of Agriculture to their mutual benefit. Such cooperation may be promoted through (1) redirecting emphasis of present courses for regularly enrolled students; (2) initiating special courses to meet specific needs of (a) women, (b) the physically handicapped and (c) older men not subject to Selective Service.

IV. *Organization for Facilitating Collaboration*

This plan anticipates mutual benefits. *First,* the

colleges and universities may thereby develop a more complete understanding of the organization, policy and activities of the Department of Agriculture, which in turn reflect the type of persons needed. *Second,* the Department of Agriculture may develop a better understanding of the problems confronting colleges and universities in training and placement.

The Department of Agriculture could arrange to send regularly to the colleges and universities current information on the department's program with respect to: (1) organization, policy, and activities of the department; (2) positions to be filled in the department including replacements; (3) educational requirements for such positions; (4) specific information regarding basic training needed; and (5) opportunities for service and permanent careers in USDA.

Colleges and universities may want to make use of information thus provided: (1) in college freshman orientation programs; (2) in college counseling programs; (3) in plans for placement; and (4) in the redirection of emphasis of course content to meet the needs of those students anticipating a career with the Department of Agriculture.

V. *Suggested Procedure for Analysis and Treatment of Wartime Training Needs*

An outline of approach for determining training needs for personnel replacement in time of war and effective methods of meeting these needs is given in the full report "A Plan for Collaboration between Colleges and Universities and the Department of Agriculture with Special Reference to Training Replacements during the War," of which this is an abstract.

It is there set forth that the Department of Agriculture: (1) determine personnel needs by jobs; (2) analyze the job to be done; (3) determine the source of replacements; (4) determine qualifications of replacements; (5) determine differential in training needed by replacements; (6) determine where such training can best be given; (7) determine that part of training which colleges could perform; (8) furnish colleges with detailed information concerning specific training needed.

To illustrate how this formula can be applied to any personnel situation, the cases of the AAA County Administrative Officer (Appendix C) and Assistant Scientific Aid (Appendix D) are explained in detail in the full report.

If it is found that a plan such as the one given is practical and feasible, the colleges and the Department of Agriculture should work out essential administrative details and proceed as soon as possible to develop the best methods and procedures for getting the job done.

The Department of Agriculture can not afford to be hampered by lack of trained personnel in this emergency. It is essential that our allies, our men in the armed forces and our civilian population may continue to eat.

SPECIAL ARTICLES

CAROTENE. I. PRELIMINARY REPORT ON DIPHENYLAMINE AS A STABILIZER FOR CAROTENE

CERTAIN commercial feed preparations for poultry and animals have been fortified with fish liver oils to supply vitamin A needed for improved growth and higher vitality. The present scarcity and increased prices may limit the use of such oils as feed supplements. Carotene, a precursor of vitamin A, is plentiful in green and yellow plant material and may be extracted and used to replace fish liver oils in food and feed preparations.

Carotene, being an unsaturated compound, is very readily oxidized, thereby losing its provitamin A value. The prevention of this oxidation is an important problem in the use of carotene as a vitamin A supplement for feeds.

It has been shown by Fraps and Kemmerer[1] that certain feeds fortified with carotene may lose as much as 70 per cent. of their carotene content in 16 weeks of storage at 28° C. These men also showed that fish liver oils added to feeds lost 79 to 100 per cent. of their vitamin A potency after four weeks' storage at either 7° C. or 28° C. Mitchell and Lease[2] have decreased the loss of carotene in dried powdered sweet potatoes by adding 10 per cent. of crude cottonseed oil. However, when stored at 37° C. the material so treated showed a rapid loss of carotene after 90 days and soon contained less than the untreated material.

A preliminary investigation has been made to determine the stabilizing effect of about 100 substances of antioxidant character on carotene. In these tests it was found that diphenylamine had the greatest stabilizing effect. More extensive tests are being made on these substances, especially diphenylamine.

Diphenylamine has been used as a stabilizer in cellulose nitrate[3] and soap[4] but has not been used in food

[1] G. S. Fraps and A. R. Kemmerer, Texas Agr. Expt. Sta. Bull. 557, 1937.

[2] J. H. Mitchell and E. J. Lease, South Carolina Agr. Expt. Sta. Bull. 333, 1941.

[3] W. W. Bradley, *U. S. N. Inst. Proc.*, 41: 125–9, 1915.

[4] R. E. Divine, U. S. Patent No. 1,542,438, June 16, 1925.

or feed. Its physiological effects are not well known. Reports show that rabbits usually recover from single doses of 0.5 to 1.5 gm per kilogram of body weight[5] and that doses of 3–10 grams given to dogs as an anthelmintic produced no symptoms of intoxication which could be attributed to the effect of the treatment.[6] This is over 1,000 times the amount needed to stabilize the animal's daily need of carotene. Biological tests are being initiated in this laboratory to determine whether small daily doses of diphenylamine have any deleterious effects upon the animal and also to determine whether this compound interferes with the animal's ability to utilize carotene.

The mixtures used in our experiments were made by adding carotene,[7] white mineral oil and stabilizer to oil-free rice bran. The mixtures were formed into pellets to reduce the surface exposed directly to air. The mineral oil was used to fill pore space and thereby cut down the diffusion of air into the pellets. Solutions of carotene in edible oils and in organic solvents to which stabilizers have been added are also under investigation.

It is known from published data that mineral oil interferes with the utilization of carotene, even when ingested in small amounts.[8] Nevertheless, mineral oil was used in order to avoid the interference of peroxide and acid formed in edible oils by oxidation so that the direct effect of antioxidants on carotene could be observed. Antioxidants and conditions found to be effective for stabilizing carotene in mineral oil will also be applied to carotene in edible oils. Preliminary tests using edible oil show a similar preservation of carotene by antioxidants.

Some of the pellets were analyzed directly after preparation. Other pellets were stored in darkness at 37° C., but freely exposed to air, for 30 days before analysis. The analysis was made by dissolving the carotene from a weighed pellet with petroleum ether, b.p. 30°–60° C. The carotene dissolved in a very few minutes and the solution was then passed through a column of dicalcium phosphate[9] covered with anhydrous sodium sulfate. The resulting clear solution was diluted to a suitable volume and its light transmission was measured with an Evelyn photoelectric colorimeter using a 420 mμ filter. The carotene concentration was determined by comparing the reading with a previously constructed transmission-concentration curve. Subsequent tests have shown that mineral oil interferes to a certain extent with the removal of oxidized products of carotene by the dicalcium phosphate, and for this reason the values reported in Table I are a little high.

The addition of diphenylamine to the mixtures caused a marked increase in the per cent. of carotene retained after storage (Table I). Two samples containing diphenylamine (Nos. 8 and 10) retained 96 and 97 per cent. of the original carotene after 30 days of storage, whereas similar samples without diphenylamine (Nos. 7 and 9) retained only 58 and 68 per cent., respectively, of their original carotene after similar storage.

TABLE I

THE STABILITY OF CAROTENE ADDED TO MIXTURES OF RICE BRAN AND MINERAL OIL

Sample No.	Ratio of white mineral oil to rice bran*	Antioxidant used†	Carotene before storage	Carotene after 30 days storage at 37° C.	Per cent. carotene retained
			Mg/gm	Mg/gm	%
1	None	None	0.63	0.06	10
2	1:10	None	0.64	0.17	27
3	1:10	Diphenylamine	0.68	0.53	78
4	1:5	None	0.60	0.31	52
5	1:5	Diphenylamine	0.64	0.57	88
6	1:5	Hydroquinone	0.64	0.50	78
7	1:4	None	0.66	0.38	58
8	1:4	Diphenylamine	0.67	0.65	96
9	1:2.5	None	0.66	0.45	68
10	1:2.5	Diphenylamine	0.66	0.64	97

* The rice bran used in these experiments was extracted with petroleum ether until free of oil.

† In all cases 5 mg of antioxidant were incorporated in each gram of mixture.

Hydroquinone, which has been recommended as a stabilizing agent for carotene in synthetic solvents,[10] was also used in these experiments. A comparison of results for samples 4, 5 and 6 (Table I) shows that the pellets containing diphenylamine retained 88 per cent. of the carotene after storage, the pellets containing hydroquinone retained 78 per cent. and those containing no antioxidant retained only 52 per cent. Similar results have been obtained in many other tests, not reported here.

There was a marked difference in the retention of carotene when various ratios of white mineral oil to rice bran were used in the mixtures. It may be noted, however, that an oil-bran ratio of 1:4 is as satisfactory as a ratio of 1:2.5 in the retention of carotene when diphenylamine is present. In the absence of diphenylamine, however, this same increase in oil content of the preparation does show an increase of carotene retention (see Nos. 7 and 9, Table 1).

It must be known from adequate tests that a sub-

[5] P. Lande, P. Derville and R. Colloft, *Comp. Rend. Soc. Biol.*, 117: 363–5, 1934.

[6] James E. Guthrie, *Proc. Helminthol. Soc. Washington*, December 7, 1940, pp. 84–5.

[7] Carotene is used herein to denote a mixture of approximately 90 parts beta- to 10 parts alpha-carotene.

[8] R. Adams Dutcher, Philip L. Harris, Eva R. Hartzler and N. B. Guerrant, *Jour. Nutrition*, 8: 269–83, 1934.

[9] L. A. Moore, *Ind. Eng. Chem., Anal. Ed.*, 12: 726–8, 1940.

[10] H. S. Olcovich and H. A. Mattill, *Jour. Biol. Chem.*, 91: 105–117, 1931.

stance is harmless when ingested by animals before it can be used in food or feed. Since such information is not yet available for diphenylamine, it is not safe to make any practical application of the results of this study.

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EDEMA IN VITAMIN E DEFICIENT CHICKS[1]

INCREASING the concentration of soluble salts in the diet has been stated by Dam and Glavind[2] to be an effective means of increasing the severity of the edema which develops in chicks fed a diet low in vitamin E. Experimental results confirming this statement have been obtained in this laboratory and were reported at the Ninth Informal Poultry Nutrition Conference held in Boston on March 31, 1942. For example, in one experiment 100 per cent. mortality resulted in a group of 9 three-week-old chicks given daily doses of NaCl solution (20 gms/100 ml) during a six-day period. Eight of the 9 chicks showed some form of edema. One of 8 control chicks given no NaCl died during the same period but showed no evidence of edema. The group given NaCl solution received 0.017 ml/gm body weight on the first day of treatment and the dose was gradually increased, reaching 0.021 ml/gm body weight on the sixth day. All chicks were fed a vitamin E-low diet consisting of dextrinized corn starch 59, dried skimmilk 20, casein 13, butyl fermentation residue 3, oyster shell flour 1, calcium phosphate 2, sodium chloride 1 and cod liver oil 1. To each kg were added 120 mg $MnSO_4 \cdot 4H_2O$, 2 mg thiamine, 2 mg 2 methyl 1–4 naphthoquinone and 1 gm choline hydrochloride.

Administration of NaCl solution was first tried because chicks fed diets similar to that given above did not develop edema as readily as did chicks fed the diet previously described,[3] which contained 54 per cent. of dried skimmilk. It appears that disturbance of the osmotic equilibrium is necessary in addition to vitamin E deficiency to cause generalized edema.

Supplementation of the diet outlined above with 20 per cent. of a practical chick mash protected chicks against edema even when NaCl solution was administered. Lower levels of the practical mash were not effective. These results were interpreted as an indication of the vitamin E content of this mash, but some doubt is cast on this interpretation by the report[2] of Dam and Glavind that inositol and lipocaic also protect against edema.

Experiments in this laboratory on the specificity of the protective effect of vitamin E were directed toward compounds having similar antioxidant properties. Toluhydroquinone, p-xyloquinone and trimethyl hydroquinone were inactive when fed at four times the effective level of alpha tocopherol. They are also ineffective when fed to rats.[4] Beta tocopherol[5] was about half as potent as alpha tocopherol, and this also conforms to the results of rat experiments.[6]

Pappenheimer, *et al.*,[7] in their extensive studies on encephalomalacia in chicks showed that the primary changes in this manifestation of vitamin E deficiency were edema and hemorrhage resulting from alteration of the capillary walls in the brain. It now appears that such alteration occurs in other parts of the vitamin E deficient organism but is not usually sufficient to permit exudation unless the normal osmotic relationships are disturbed. The question may well be raised as to the possible relationship of capillary changes to the various manifestations of vitamin E deficiency in other species.

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[1] Scientific paper No. A36a, Contribution No. 1857 of the Maryland Agricultural Experiment Station (Department of Poultry Husbandry).

[2] H. Dam and J. Glavind, SCIENCE, 96: 235, 1942.

[3] H. R. Bird and T. G. Culton, *Proc. Soc. Exp. Biol. and Med.*, 44: 543, 1940.

[4] C. Golumbic and H. A. Mattill, *Jour. Biol. Chem.*, 134: 535, 1940.

[5] Alpha and beta tocopherol and trimethyl-hydroquinone were furnished by Merck & Co., Inc., Rahway, N. J., through the courtesy of Dr. D. F. Green.

[6] P. Karrer and H. Fritzsche, *Helv. Chim. Acta*, 22: 260, 1939.

[7] A. M. Pappenheimer, M. Goettsch and E. Jungherr, *Conn. Agr. Exp. Sta. Bul.*, 229, 1939.

ISOMORPHISM AND ISOTYPISM AMONG SILICATES AND PHOSPHATES

RECENT advances in the study of isomorphism and isotypism may be illustrated through examples taken from compounds related to two mineral groups, the garnets and the apatites. Investigations by numerous chemists and mineralogists have revealed new isomorphic and isotypic relationships among silicates and phosphates, such as the isotypism of $AlPO_4$ and SiO_2 reported by Huttenlocher. However, a complete discussion is beyond the scope of these brief comments and complete references to the diverse sources of the data are purposely omitted.

Isomorphism, in the sense of the mineralogist, is characteristic of those compounds which exhibit stereochemical miscibility (so-called mixed crystals). Limited isomorphism obtains when the stereochemical miscibility is limited, whereas complete isomorphism exists when numerous intermediate members have been proven.

Isotypism overlaps to some extent the chemist's concept of isomorphism; it denotes compounds of equivalent structural types. Nevertheless, it is apparent that ionic substitution of the isomorphic sort is not a part of the connotation of isotypism. Actually the distinction between isomorphism and isotypism is somewhat arbitrary because it depends upon our knowledge of the mutual relationships of the compounds. Although miscibility among several isolated compounds may be unknown at present, the existence of one or more intermediate members, and hence limited or complete isomorphism, may be demonstrated at a later date.

Elementary texts on mineralogy may show the composition of garnets as $R''_3R'''_2(SiO_4)_3$, suggesting within this group the isomorphism which is well known. However, a more complex type formula is necessary to cover the phosphates, arsenates and hydrates which are now recognized as isotypes. These are:

$Ca_3Al_2(OH)_{12}$
$Ca_3Fe_2(OH)_{12}$
$Ca_3Al_2(SiO_4)_2(OH)_4$ (Pabst)
$Na_3Al_2(PO_4)_3$ (Thilo)
$(Ca_2Na)Mg_2(PO_4)_3$ (idem.)
$[Na(Ca,Fe)Al]Mn_2[(PO_4)_{2.5}(OH)_2]$ (McConnell)
$(Ca_2Na)Mg_2(AsO_4)_3$ (Bubeck & Machatschki)
$(Ca_2Na)Mn_2(AsO_4)_3$ (idem.)

These garnetoids have the type formula $X_3Y_2(ZO_4)_{3-m}(OH)_{4m}$, all are cubic and, with one probable exception, all have the space group of the common garnets (anhydrous silicates).

Isomorphism has not been demonstrated among these compounds except for the first three (Flint, McMurdie and Wells) and the last pair. However, P_2O_5 has very recently been found to the extent of about four per cent. (Mason and Berggren) as a constituent of a silicate garnet, demonstrating at least limited isomorphism of spessartite and a phosphate garnetoid. Replacements of R″ of the simple text-book formula are not necessarily bivalent elements, nor are the replacements of R‴ necessarily trivalents, although these valence conditions are almost universally fulfilled among the common garnets.

Turning to the apatites, the examples become even more complex but, again, a general formula may be devised: $X_{10}(F,OH,Cl)_2(ZO_4)_6$, where X is usually Ca or Pb, and Z is P, As or V. These compounds have been known for many years and will not be discussed. Several isotypes have been described recently and some of these are of considerable interest. They are:

$(Ce_{3.5}Ca_{3.5}Na)(OH,F)_2[(SiO_4)_{4.5}(PO_4)_{1.5}]$ (Hägele & Machatschki)
$(Na_6Ca_4)F_2(SO_4)_6$ (Klement & Dihn)
$Ca_{10}(OH,Cl,F)_2[(SiO_4)_3(SO_4)_3]$ (McConnell)

The last of these seems to form a complete isomorphous series with the corresponding phosphate compound, $Ca_{10}(F,OH,Cl)_2(PO_4)_6$.

Another very interesting feature of the isomorphism of apatite is the limited substitution of C for P, together with the suggested substitution of C for Ca. The isotypic carbon compounds, however, have not been discovered and probably do not exist. A more or less complete list of the substitutions, then, is:

X $\backsimeq$ Ca, Mn, Sr, Na, K, Ce, and, in lesser amounts, Y, La, Th, Ta, Fe, Al, Mg, and C (?).
Z $\backsimeq$ P, As, V, S, Si, Cr, and C.

Some of these are strange bedfellows indeed.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A DEVICE FOR CALIBRATING SMALL AIR PUMPS

To measure the concentration of moisture in the air at two or more levels, in connection with the development of a method for determining the rate of evaporation from land surfaces,[1] a chemical absorption hygrometer satisfactory for field use was devised.[2] An essential element of the hygrometer is a reciprocating pump of approximately 5 cc capacity per stroke, which for satisfactory operation must be accurately calibrated. Since the device that was developed for making the calibration may have other laboratory uses, it is described in the following note.

The essential operation of the device is replacing an unknown volume of air with an equal volume of water, the transfer taking place at atmospheric pressure and measuring this volume of water.

In Fig. 1, a diagram of the device (a) represents a liter flask in which water replaces a volume of air to be measured. The flask has a drain valve (b) in the bottom and a graduated glass stem (c) in the top. In the upper end of the stem is a three-position valve (d) through which flask (a) is opened or closed to the atmosphere or connected to the intake of an air pump. The stem is enlarged below valve (d) to enclose a spout (e) which is a water passage from reservoir (f) to flask (a). A glass tube (g), opened

[1] C. W. Thornthwaite and Benjamin Holzman, *U. S. D. A. Tech. Bull.* No. 808, May, 1942.

[2] C. W. Thornthwaite, *Trans. Amer. Geophys. Union*, pp. 429–432, 1941.

to atmospheric pressure, extends into reservoir (f) and the tube is adjusted so that its lower end will be at the level of spout (e). The operation of the device depends on this adjustment. Valve (h) releases air trapped when filling reservoir (f) with water.

The intake of an air pump to be calibrated is connected to valve (d) and this valve closed to the pump and atmosphere. Valve (b) is closed and valve (h) opened. Reservoir (f) is then filled with water through tube (g). As reservoir (f) is being filled an amount of water will flow through spout (e) into

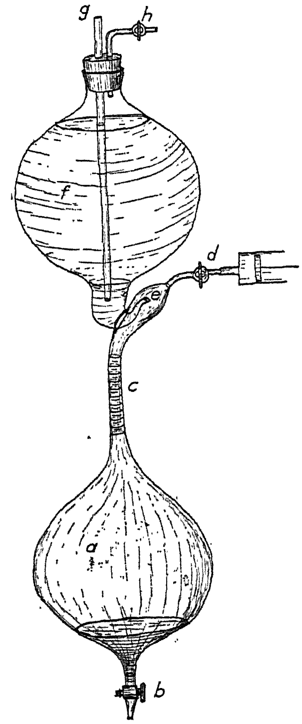

FIG. 1.

flask (a) which maintains air pressure in flask (a) equal to the head of water above spout (e). When reservoir (f) is full valve (h) is closed and the three position valve (d) opened to the atmosphere. Releasing the air pressure in flask (a) causes pressure readjustments in reservoir (f) and sufficient water will drain from the reservoir to establish less than atmospheric pressure above the water in the reservoir and atmospheric pressure at the surface of the water in spout (e) and the end of tube (g). The excess water in flask (a) is drained to a zero mark on the stem of valve (b). Valve (d) is closed to the atmosphere and opened to the pump. The apparatus is now ready for a pump calibration.

As the pump exhausts air from flask (a) the pressure in flask (a) tends to decrease, but a spontaneous adjustment of pressures in the system takes place which maintains atmospheric pressure in flask (a). The process of adjustment is: decreasing pressure on the surface of the water in spout (e) forces water from reservoir (f) into flask (a) until the pressure in flask (a) is brought back to atmospheric pressure. At the same time water flowing from reservoir (f) decreases the water pressure in reservoir (f) and air will be forced into reservoir (f) through tube (g) until atmospheric pressure is again reached in the water at the level of spout (e). Thus the device maintains atmospheric pressure in the flask (a) and any volume of air pumped from this flask will be replaced by an equal volume of water.

For a calibration the pump is run until the water flowing into flask (a) has reached the graduations on stem (c), from which its volume can be determined. This volume divided by the number of strokes made by the pump during the operation gives the volume per stroke of the pump.

The pressure of the air enclosed in the system is affected by any temperature change, and any variation in this pressure affects the accuracy of the device. To eliminate this source of error all parts of the system should be at a uniform temperature, and as the enclosed air responds more rapidly to temperature changes than the water the temperature range, during a run, should be kept to a minimum. Another source of error is incomplete water drainage from flask (a) between runs. This can be avoided by keeping the glass chemically clean.

J. C. OWEN

CLIMATIC AND PHYSIOGRAPHIC DIVISION,
SOIL CONSERVATION SERVICE

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SCIENCE NEWS

Science Service, Washington, D. C.

LOESS AND THE FARM LANDS OF THE UNITED STATES

Some of the best farm lands in America are the product of unimaginably violent dust storms—dry, gray blizzards that howled off the edges of the vast glacial sheets of the Pleistocene Ice Age. They are the wind-deposited soils known technically as loess, that are found over wide stretches of the Midwest and also (though more thinly deposited) in parts of the East.

Wind has long been credited with the creation of the loess, but there have been many things about this soil type that have puzzled geologists. New light is thrown on the problem by Professor William H. Hobbs, of the University of Michigan, as a result of long studies around the ice sheet that covers Greenland—one of the two places on earth where Ice Age conditions still persist.

During Greenland's short but often surprisingly warm summers there is very rapid melting around, and just within, the glacial margins. Heavy floods of water, turbid with suspended mud and sand, pour out, frequently floating off blocks of ice with boulders embedded in them. These eventually become stranded and melt, dropping their boulder loads at considerable distances from the edge of the main ice mass. Geologists know all this solid discharge from under the glacier edge by the vivid name of "outwash."

When the long winter sets in, bitterly cold winds, at velocities of a hundred miles an hour and more, pour down off the interior of the ice sheet. The outwash is soon dried out, and the lighter particles blow outward in great clouds. Sandstorms at lower levels, dust storms at all levels, rule the season. Except for temperature, conditions are not unlike those encountered in the Libyan desert. Exposed stone surfaces are sand-blasted in almost exactly the same manner in both regions.

The outward-blowing dust is halted only by vegetation and does not, therefore, settle permanently upon the outwash plain itself. Around the outwash area it builds up a heavy deposit of the loess, which is thickest about the rim of that area and thins out the other ways. Thus it comes about that in the upper Mississippi Valley the loess has been deposited peripheral to the areas occupied by the last ice sheet, but with an intervening area wherever there has been outwash deposited. This distribution of the loess has long been recognized by glacialists, but has never before been explained owing to the failure to take account of the so-called glacial anticyclone over continental glaciers.

Professor Hobbs has found abundant evidence of the same state of affairs in the abundance of wind-sculptured boulders, in the inland sand dunes of Nebraska, and in the distribution of the Midwestern loess which covers whole Corn-Belt counties and piles up in hills as much as 300 feet high along the banks of the Missouri.

FLUID COAL

"Fluid" coal, a pulverized form of coal which, when mixed with air, can be made to flow through standard pipes a quarter of a mile long, is being studied by fuel engineers at Battelle Memorial Institute, Columbus, as a possible substitute for fuel oil in industrial heating processes.

Preliminary work on the application of this finely ground coal to industrial furnaces—which application if widely adopted may have great effect in alleviating shortages of fuel oil—has demonstrated that the fuel is entirely suitable for use in many types and sizes of forging furnaces, that it has advantages of fluidity similar to those of oil and gas, and that it gives flames of high emissivity which provide maximum heat transfer by radiation.

Of particular importance is the fact that for most sections of the country this material would be more economical for applicable industrial processes than the fuels now being used.

Investigations in the uses of pulverized coal have been in progress at the Columbus industrial research laboratory for several years and are now being intensified under an enlarged research program supported by the bituminous coal industry. Emphasis is being placed upon the application of the finely pulverized coal to forging, heat-treating and other metallurgical furnaces, which now consume great quantities of oil and gas in the war industries.

"Fluid" coal is produced by grinding coal to dustlike fineness in specially designed mills. A stream of air entering the mill picks up the fine particles and delivers them to collectors. The material when not impacted will flow through your fingers and pour somewhat in the manner of a liquid. When mixed with air it demonstrates fluid-like properties, will flow through pipes, and spray out of jets.

That the substitution of pulverized coal for oil and gas in some metallurgical processes is entirely practical is verified by the fact that a number of plants have been using pulverized coal for steel-heating furnaces for many years. In fact, in 1920—in the days before oil and gas became cheap—there were 690 known pulverized coal furnaces in operation in this country. The development retrogressed, however, with the discovery of vast new sources of oil and gas and the sharp reductions in the costs of these fuels.

The investigations indicate that there is great possibility of extending the use of pulverized coal to hitherto unexplored fields. It has been tried in the radiant-tube furnace, which is used in heat-treating, annealing, and enameling, with promising results. The successful application of pulverized coal to this type of furnace would remove the principal disadvantage of coal in refined metallurgical work, namely, the fly ash, cinder and sulphur, since combustion takes place inside alloy-steel tubes lining the walls of the furnace.

Finely pulverized coal ignited in air burns rapidly, releasing great quantities of energy. A part of the Battelle investigation of this fuel, but one having less immediate application in industry, is the study of a direct means to harness this energy.

THE CHEMISTRY OF THE HIGH POLYMERS

DR. H. MARK, professor of organic chemistry at the Polytechnic Institute of Brooklyn, speaking before the North Carolina State College chapter of the Society of Sigma Xi, stated that the difference between a springy rubber-like substance and a hard plastic or a tough fiber, either synthetic or natural, lies in the tendency for the molecules of these substances either to contract or to form crystals.

The more crystallization in its structure the more the substance becomes a typical fiber, such as nylon, silk, cotton or rayon. If the mutual attraction between the chain-like molecules of a given material is low, then it will show mainly the properties of an elastomer such as rubber, Buna S, Neoprene, Hycar, butyl rubber, etc. This is also true if the molecules do not fit well into a regular three-dimensional lattice structure. In between these extremes, the substance will show the properties of a plastic, such as hard rubber, methacrylate (lucite), vinylite, polystyrene or ethyl cellulose. Present experimental knowledge shows that all these substances have about the same fundamental structure, but it is their ability to crystallize that gives them different properties.

All types of what the chemist calls "high polymers," whether they be rubbers, plastice or fibers, have the same high order of polymerization, that is, their molecules are composed of about 2,000 or more atoms. "Polymerization" is the name that the chemist gives to the process of making big molecules out of little ones. Either by natural processes or by the skill of the chemist's reactions, simpler materials are built up into more complex ones to form our most useful rubbers, plastics and fibers. These are molecules in which the atoms are visualized as being in a long chain.

"During the past fifteen years," Dr. Mark said, "a new branch of organic chemistry has been started and gradually developed. This is the chemistry of the high polymers. The natural products belonging to this class of substances, for example, cellulose, starch, proteins, chitin, rubber, etc., have been known for a long time, but it was only recently that successful attempts were made to elucidate their molecular structure and to realize their common fundamental building principle. Synthetic products of resinous character built up from small molecules, such as formaldehyde, ethylene oxide, vinychloride and styrene, have also been known for some time, but again their molecular structure and their fundamental relationship with the natural high polymers were not known until about ten or fifteen years ago."

ITEMS

COLCHICUM, the plant that produces colchicine, is not immune to the effects of its own drug, is indicated by experiments by Dr. Ivor Cornman, of the University of Michigan. Since colchicine produces the sudden evolutionary changes in plants that have made it famous in recent years by a partial checking of cell division, giving new cells two or more times the normal number of heredity-bearing chromosomes, Dr. Cornman made his tests simply on cell division in root tips of two species of Colchicum. Weak colchicine solutions had no effect, but when the strength was stepped up to 2.5, 5 and 10 per cent. the cell-division process was seen first to be hindered, then blocked altogether. Since there is always colchicine in the tissues of Colchicum, the question naturally arises, how can cell division go on at all? Why doesn't the plant make itself extinct with its own poison? Dr. Cornman doesn't undertake to answer. He merely remarks that the immunity must be found somewhere else than in the plant's mechanism of cell division. Details of the research are reported in the *Botanical Gazette*.

How cattle and sheep are aided by bacteria in digesting the crude fiber of the grass and fodder they eat has been demonstrated by a new technique devised by F. Baker, of the Guilford County Technical College, England. Mr. Baker's method is described in a statement from the Science Committee of the British Council. Partially digested materials are removed from the animals' digestive tracts either in the slaughter house or from specially prepared surgical openings in living specimens. Under the polarizing microscope, differences in light direction through the materials indicate digested and undigested parts. The role of the bacteria is indicated when iodine is added. Where the bacteria are active, purple spots show the presence of starch-like substances, formed within the bacterial cells out of the cellulosic materials in the crude fiber. Apparently it is this bacterial starch that actually furnishes the nutrition to the animals.

COLOR changes in the test tube will enable chemists to measure amounts of the silver-white metal, palladium, in solutions as dilute as 1 in 300,000,000 parts. The method was developed by Dr. John H. Yoe and co-workers at the University of Virginia. This is the first procedure to be discovered which will detect such minute traces of the metal. It will be useful in analyzing and studying the platinum group of metals and their alloys. Palladium is used in dentistry, jewelry and to speed certain chemical reactions. A new color method for detecting traces of iron as small as one part in 75,000,000 was also discovered. Analysis by weighing, rather than a color change, is the final step in a procedure to test tungsten ores and steels, an important metal in war production. These investigations were part of a research program being conducted by Dr. Yoe and his associates to discover new and more sensitive organic analytical solutions for detecting and determining amounts of chemical elements and their compounds. Such studies have important applications not only in chemistry, but also in medicine and biology.

EXPERIMENTS performed by Professor E. H. Hughes and R. L. Squibb, of the University of California College of Agriculture, indicate that pigs as well as people need vitamins. The newest need on the porcine diet list is pyridoxine, member of the vitamin B complex also known as B_6. Lack of this compound caused a number of distressing (and costly) symptoms, including loss of appetite, poor growth, fits and anemia. Normal health was restored by daily doses of a mere pinhead quantity of pyridoxine—five milligrams per hundred pounds of pig.

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PEACETIME VALUES FROM A WAR TECHNOLOGY[1]

By Dr. GUSTAV EGLOFF

DIRECTOR OF RESEARCH, UNIVERSAL OIL PRODUCTS COMPANY, CHICAGO, AND PRESIDENT, AMERICAN INSTITUTE OF CHEMISTS

Introduction

In a world at war one gets the impression that all forces are solely for destruction. When war ends, the new technology will more quickly, efficiently and effectively convert the war effort to the pursuits of peace with an amazing speed. With the tremendous increase in research and development, the commercialization of processes has occurred which would have taken years under normal conditions to reach fruition. Out of the welter of the war effort, values will flow that will increase man's effective span of life with greater satisfaction for living.

Science has already prolonged and saved man's life through germ-killing chemicals, new anesthetics and synthetic vitamins. Through scientific and technical research our food supply has increased in quantity and quality. Synthetic textiles have provided us with more beautiful, durable and sanitary clothing. Plastics will revolutionize the building arts, for the trend is to supplant many house-building and house-furnishing materials with plastics as soon as they can be released for civilian use. Plastics together with new and more efficient fuels will also play a dominant part in our transportation systems.

Let us look at the transportation situation first. The petroleum industry will play a controlling part in this. Airplanes hurtling through the air at over five hundred miles an hour carrying a thousand or more passengers will make all parts of the world less than twenty-four

[1] Presented at the Wartime Marketing Conference, American Management Association, Drake Hotel, Chicago, January 14, 1943.

hours away from Chicago. Luxurious as the *Normandie* and *Queen Mary* were for ocean travel, airships yet to come will operate with a smoothness and comfort unknown to-day. Low cost air travel and jitney planes should be within the pocketbook of every American. The competitive impact of the new airplane industry on all other forms of transportation may be quite serious.

Increase in air travel will be made possible primarily by the capacity of the oil industry, increased by wartime demands to produce 100 and higher octane gasoline, and by the amazing developments in airplane design, material and construction that have been forced by the hard hand of war necessity.

The same technique and the same processes that produce 100-octane gasoline in almost unlimited quantities for airplane use will also mean greatly improved fuel for automobiles; in fact, at least 50 per cent. more miles per gallon. We may hazard a guess that the automobiles to come after the war will give new pleasure to driving because of their improved design, speed, safety and beauty.

In the short span of twenty-five years, man has entirely revolutionized transportation through the design and construction of the automobile and airplane and petroleum products. By careful study and experimentation, it is certain we can produce from petroleum better rubber than was ever obtained from trees or plants, and tires which will give 100,000 miles or more of trouble-free service are a reasonable expectation of the future.

For years we have been led to believe that world leadership in research and development rested squarely on Germany and that the United States was laggard. Even now statements are made from time to time to the effect that we are still behind Germany in research, development and commercialization. This is not so to-day with the facts. There was an element of truth in such a statement during World War I when the United States was short of many necessary materials due to its reliance on Germany for pharmaceuticals, dyes, fine chemicals, potash, lenses, chemical glassware, instruments, etc. We are now completely independent of any country for these and other materials.

Prior to the previous war it was thought that if one wanted to study chemistry, physics, mathematics or medicine, one had to go to Germany, but that day is also gone forever. In less than twenty-five years the United States has reached world leadership in research and has awakened to a miracle of scientific and technological development under our system of free enterprise.

Private initiative is responsible for America's world leadership in science and industry. The tremendous effort that is being put forth in the United States, the effort that will win the war, is the work of private initiative.

The impact of researches, carried on by private corporations and speeded up enormously by the war, will bring vast changes in our peacetime economy. Their research departments were the organizations upon which many companies relied to bring them out of the depression. Their results are the backbone of the country's mobilization for total war.

Obviously, in the time allotted this evening one can but show a few highlights in the accomplishments of research.

The fact that many of nature's products have been unsatisfactory has stimulated man's inventive faculty fortified by the vision prevailing in our industries. The tremendous cooperation of industry in the United States is responsible for the spending of millions of dollars to develop a basic idea for the welfare of mankind. No industry stands alone in achievement, as they are all interrelated through research.

The destructive nations' efforts to rule the world must be wiped out as surely as we must defeat the insect and bacterial hordes that prey upon us.

HEALTH ENGINEERING

Man's struggle to survive is ever present. He has either vanquished or domesticated large animal life. Our present battle is to overcome the ravages of rats, insect life and bacteria; it would seem that the smaller the scale of life the more difficult is the problem of its extermination or control. Even the very nature of some of the smallest forms has presented man with some of his greatest difficulties of discovery and eradication by chemical or physical means. Great strides in this direction have been made, but the ultimate solution is still far off. Increased tempo in research and experimentation along many fronts will ultimately present the remedy, but with the vastly improved tools man is constantly providing for himself, the end is certain to be on the favorable side for mankind.

From the necessities that war has forced upon man have grown the scientific principles of health engineering so vitally necessary to man's well-being as a fighting force. Accurate knowledge of vast areas hitherto seldom visited by dwellers in temperate regions have been the motive force behind a medical exploration of tropical territories that may well be carried over in the future development of our own hemisphere.

When it became necessary to provide troops with anaphylactic measures against tropical and sub-tropical diseases, it was the problem of the medical force to provide accurate knowledge of the type of health dangers encountered and to provide prevention and

cure of malaria, cholera, typhus, hookworm, bubonic plague, sleeping sickness, dysentery and typhoid. Mosquitoes, rats, leeches, fleas, flukes, bats and a host of other disease-bearing or spreading agents had to be studied and their control and extermination planned. Drugs of all types had to be ready for disease combat and the checking of infection.

In the Far Eastern and African campaigns insects and infections have beset our armies. Our men went down with malaria and other diseases. Among these are dengue fever, dysentery, tropical ulcers and sores, as well as the bites of malarial mosquitoes and tropical spiders, some as large as crabs. There is a drainage of the soldier's vigor in this pestilential atmosphere wherein he fights, eats and sleeps but a few hundred miles from the Equator. As one eyewitness expressed it about the Buna campaign:

> . . . that every ounce seems to grow to 10 pounds when carried through a jungle through knee-deep mud. That means giving soldiers jungle equipment, including the lightest kinds of carbines, tropical uniforms, waterproof shoes, more efficient and lighter packs, as well as smaller mosquito nets.

What has research done to modify this type of torture and death to which our fighting forces are subjected? The methods of attack are chemical, physical, medical and engineering.

An indispensable tool in the study of man's health for many years has been the microscope, discovered over three hundred years ago. Slow improvements had been made in this instrument until a few years ago when a revolutionary principle was discovered through the use of the electron. This made possible a magnification of over 200,000 times compared to the 3,000 from the best previous microscope.

Anti-insect sprays, delousing, swamp drainage, felling of certain trees, sanitation, oil and chemical dust spreading and other methods are used to keep our troops in fighting condition and will have great value industrially and agriculturally during peace.

A number of synthetic chemicals, such as the sulfa drugs, synthetic quinine and synthetic vitamins are finding amazing uses on the fighting fronts. Where the World War I record was four deaths out of five due to germ infection of abdominal wounds, the present record is one out of five. Quoting Howard Blakeslee:[2]

> On the 2,000-mile front, in all the war, only 1.5 per cent. of the Russian wounded have died. That is slightly higher than the remarkable recovery rate at Pearl Harbor, 96 out of each 100. The report says the Russian recovery rate is 98.5 per cent. of all wounded. The Russian rate is one-half of 1 per cent. worse than the Guadalcanal miracle of 1 per cent. of wounded dying. . . .
>
> The Russians claim some new medical advances of their own. When plasma is made in America, the red blood cells are thrown away. The Russians report that they have made a process to use these cells to manufacture blood. Nerve sections taken from the dead have been successfully grafted into the wounded. The peritonea of animals, the inner linings of visceral cavities, have been used as living bandages for gaping wounds. It is claimed that cure is facilitated and that the scars are not so heavy. . . .
>
> A compound that is not a vitamin, yet has the blood-clotting effects of Vitamin K, is in use. The Russians say they have found a method to obtain thrombin in thousands of quarts volume. Thrombin is a natural clotting substance in blood.

The latest sulfa drugs which are working wonders against infection and disease are sulfathiazole, sulfapyridine, sulfaguanidine and succinyl sulfathiazole which have been synthesized for specific diseases. Each soldier's kit contains first aid doses of sulfanilamide for the purpose of checking infection at the time a wound is received.

Pentothal, which is injected intravenously, is one of the very best of the newer anesthetics, having no explosive hazards such as ether and the hydrocarbon gases. In addition, the equipment necessary for its administration is simple. A shot in the arm is all it takes to put one asleep.

Bacteria, soil molds and molds found in the intestines of animals or insects create chemicals that are highly useful in destroying infection. Penicillin, a new drug produced in soil mold, is about 100 times as effective as sulfanilamide for combating infection and far less toxic. Gramacidin from soil bacteria has been found to be a powerful germicide for both pneumococci and streptococci, two extremely dangerous germs to man.

One can not pass public health without mention of the vitamins. Many diseases of baffling nature have been due to dietary deficiencies and upon treatment with the proper vitamins have been cured. New methods of production, mainly chemical synthesis, have made vitamins available. Vitamin C (ascorbic acid) and Vitamin B_1 (thiamin chloride) are probably the most outstanding examples. In 1933 the cost of Vitamin C was $213. per ounce; in June, 1942, the price had been reduced to $1.65 per ounce. Vitamin B_1 was sold for $8,000 per ounce in 1935 and is now marketed at $15.00 per ounce. Because of the huge reductions in price, these vitamins as well as several others can be added to fortify various foods, giving them protective factors for health never before included in their manufacture.

FOOD

Food plays the dominating role in all nations. Rationing has hit all of us, hence our keener interest in this subject. Research has made available foods relatively new to our civilization, not alone from the standpoint of new varieties but chemicals used for

[2] *New York Times*, January 10, 1943.

treatment increasing their quality, size and vitamin content.

Petroleum plays a role in the newer methods of increasing food supply. When oil is cracked to produce motor fuel, olefinic gases are by-products. These gases, such as ethylene, propylene and butylenes, hasten fruit ripening and growth. Ethylene was first used for the purpose of ripening oranges rapidly, by putting a tent over each tree or storing the unripe fruit in a room and adding small percentages of ethylene. By using this method of ripening, the fruit could be shipped without loss due to rotting. The growth of potatoes has been stimulated by ethylene and propylene. It has been reported that the speed of growth of potatoes has been increased 100 per cent. when the seedlings have been treated with ethylene. The growth time to maturity was shortened, while at the same time the potatoes were more numerous and larger and contained higher percentages of Vitamin C.

The Russians have studied the use of butylene gas, showing that it has a stimulating effect on the speed of growth of trees, such as the apple, apricot, pear, cherry, plum, peach and walnut, bringing them to fruition far faster than without its use. Where the growth season is too short to allow the full maturing of trees due to the inclement weather in parts of Russia, so that flower formation and fruit setting are delayed, butylene has been used to hasten the growth period. The method of treating a tree is to enclose it in a tent for two weeks before the normal or desired leafing, *i.e.*, start of the growth cycle. Butylene is passed into the tent in concentrations of one part in a hundred thousand parts of air at temperatures between 69 and 100° F. for a period of one to two hours. Small heaters are probably used to raise and maintain the temperature of the air around the tree so as to obtain maximum effects of the growth-inducing hydrocarbon, butylene.

Acetylene, so important in the production of synthetic rubber, plastics and other materials, is being used in Australia to increase the growth of pineapple plants. Calcium carbide, derived from coal and limestone, is placed in the heart of the plant, and rain or dew reacts with it to produce acetylene in sufficient quantities to increase the growth of the pineapples.

In California, fruit orchards are fertilized by ammonia added to the irrigation water, which has markedly improved productivity. It may be of interest to point out that this ammonia is produced from the nitrogen in the air and the hydrogen from cracking of petroleum.

The autumn crocus contains a yellow powder called colchicine, which is extracted from the plant. This powder when applied to seeds, leaves or buds of a plant increases growth of fruits and vegetables to double their normal size. Colchicine also gives rise to new varieties of fruits and vegetables never known before. The colchicine acts at a very critical point in the germination of the seeds. When cell division is ready to take place, the cell does not divide, which is usual in nature, and the specie-bearing chromosomes remain in the seed in double the number, giving rise to new species of fruits and vegetables.

Shipping of food supplies to the United States fighting men abroad is in a critical situation because of lack of transportation. To overcome this obstacle a number of processes have been developed to dehydrate foods in order to cut down their bulk and weight.

"Quick freezing" of fruits, vegetables and meat has added materially to food supply, particularly in decentralized communities, and also conserves steel and tin in the form of cans. This development has great economic value for peace and war.

The impact of these researches on the food economy of the world will develop enormously in that one may work out new hormones and chemical stimulators which will give rise to new plant life.

Developments already achieved present an almost incredible picture of our food supplies of the future. Obviously these developments will make it possible to raise more food of higher nutritive quality on less acreage, with far less labor compared to present methods.

Textiles and Clothing

For years the silkworm was the sole producer of the raw material used in weaving fine silk fabrics symbolic of richness and luxury. Marco Polo in the fourteenth century introduced these fabrics into Europe. The products from the silkworm held leadership for centuries as a symbol of wealth. The silkworm's job is well-nigh finished, although silk will probably find a number of special uses. The research chemists have developed synthetic silks far superior to the best that the silkworm can do. Rayon is one of the earliest of the silk substitutes and was produced primarily from wood and cotton linters.

The most striking development in the textile and plastics industries in the past few years is the commercial production of Nylon. One of the main uses of Nylon was for hosiery that has at least ten times the wear quality of the best silk from the worm. Nylon is now used largely in parachutes and for ammunition bags, in which it replaces natural silk.

Structural Materials

After World War I a great impetus was given to the building arts. Structural steels, alloys, aluminum, concrete, synthetic stones, plywoods, insulators, plastics and a host of other materials were generally made

available. A new era in design, building, housing and transportation will be the aftermath of the present war with the many new materials now produced which will be diverted from the war to peace. A tremendous business potential is ahead of all of us, which will strain us to the limit to fulfill the demands of building, furnishings, automobiles, trains, etc.

GLASS

For thousands of years almost no progress was made in the glass industries of the world. The only researches of moment were through the addition of minerals to give beautiful colors to the windows of the world's cathedrals. Researches in the glass industry of the United States since World War I have made amazing strides in the materials that can be produced from sand. In World War I this country was cut off from the chemical glassware and lenses of Germany, which held leadership at that time. We are now entirely independent of any foreign country, for we have developed new products from sand that are leaving their impact upon other industries in a competitive way that will be intensified in the peace period to come. Mass production of hard glass for laboratory use has found its way into everyday life in its use for baking and other heat-resisting utensils. In addition to this development, the present war is bringing out the utility of glass in jobs which were previously taken care of by steel, silk and cork. Glass fiber boards for heat insulation in fighting planes have saved five and one-half million pounds of aluminum and other scarce lightweight metals which can be used in building 250 Flying Fortresses. For electrical insulation, glass filaments are spun which make a flameproof wire coating for use in heavy bombers. Glass foam has found use in displacing cork in life preservers and life boats. Unlike air-filled rubber floats, a puncture is not vitally destructive, since, when a bullet passes through, only the cells in the immediate vicinity are destroyed. One of the outstanding uses of spun glass in the present war is as a replacement for silk and gut in surgical sutures. Spun glass is also widely used as a fireproof textile. Some of the newer optical glasses use no sand at all, but depend upon the rare earth elements such as tantalum, tungsten and lanthanum. The glass made from these materials is highly satisfactory for use in aerial photography lenses, since it gives more sharply defined images at higher altitudes than ever before possible.

PLASTICS

The plastics industry was founded years ago by Hyatt, an American. He was the first to work with cellulose nitrates and camphor as a plastic mass in an effort to find a substitute for the ivory in billiard balls. In general, however, the founding of the modern plastics industry occurred in 1907 when Dr. Leo H. Baekeland produced in his laboratory in Yonkers, N. Y., the first phenol-formaldehyde products, commercially known as Bakelite. This American research was the stimulating force that has brought the plastics industry to the important position it now holds in our war effort. World leadership in the plastics field is without question in the United States. One can be clothed from head to toe by plastics that are now available. One may live in a plastic house and be transported in vehicles largely made of these materials. There is no end to the variety of plastics that are potentially available and in the making.

These remarkable plastics have at least 100,000 uses. Perhaps one of the most important at the moment is for the production of hoods for pilots and gun turrets on airplanes, where prolonged high visibility is so essential. One of the most important plastics is Plexiglass, made of methylmethacrylate. The flexibility of this material lends itself to forming any shape desired by molding. In addition to clarity of vision, which these plastic windows give for a long time, they are practically shatter-proof.

It is to be expected that in the automobile to come plastics will play a great part in its structure. One may expect practically 100 per cent. visibility in the new type car based on plastics. For these uses it will be highly competitive with other types of structural materials.

Much has been accomplished in the United States in brightening life, housing and transportation by the use of plastics of every color. One may say that the period in which we are living is the renaissance of color. This reawakening to color values was apparent before the global blackout. Many plastic products form excellent media in which the commercial artists and designers have expressed their art in home and business interiors. Current United States magazines are full of beautiful illustrations of radios, electric irons, telephones, airplanes, milady's boudoir, many of which are made of plastics.

The color effect of these plastics plays a definite role in the well-being of humanity and in our capacity for work. This industry of color effect from glasses and plastics has not been fully exploited. However, a number of manufacturing plants have worked out color schemes that raise the tempo of production and ease fatigue at the same time. Eyestrain particularly is in general an overlooked factor in well-being and productivity. Walls of dull gray, brilliant white and black machines in many cases contribute to accidents. The fatigue factor also holds for office work and study should be given to the relation of color to accuracy and output of those engaged primarily in mental activity.

In general, the architect in planning buildings has limited himself as regards color to a comparatively narrow range, gray portland cement, red sandstone and gray, red, and yellow bricks, etc. Newer building plastics are available in colors as beautiful and far more practical than precious stones whose colors they imitate. The architect could well use plastics in slabs that would give us colorful buildings at low cost.

One may expect that the new plastics will play a competitive role with building and window glasses. Both the plastic and glass industries will also be highly competitive with the paint and varnish industries.

SYNTHETIC RUBBER

We were caught with our natural rubber supplies shut off by the devastating attacks of the Japanese, who now control over 95 per cent. of the world's rubber supplies. In normal times the United States requires about 600,000 tons for its peacetime pursuits. Fortunately science and research in the United States were not caught napping in the knowledge and technique for the production of synthetic rubber. For a matter of twenty years or so, long before the fall of the Far East, processes were available to produce synthetic rubber. The production schedule is for 1,100,000 tons of synthetic rubber for the war effort. The synthetic rubbers, Neoprene, Thiokol and Ameripol, were in commercial production prior to the fall of the East Indies. The "know how" of producing other rubbers, such as Buna-S and the butyl type rubbers, was also available. The United States has all the raw material necessary to produce any quantity. It is now a question of materials and their fabrication to equipment in order to construct the plants already O.K.'d by the government.

Neoprene rubber is based upon acetylene—the same acetylene that induces plant growth and is the basis of a whole host of other products.

Acetylene is one of the most important of all the hydrocarbons, and has been produced through the years almost entirely from coal and limestone in electrical furnaces. One of its primary uses for years has been in acetylene welding and now in synthetic rubber. Researches have been going on for years in an endeavor to use our vast natural gas and petroleum resources for the production of acetylene. There are a number of commercial units now under construction, one of which will produce at the rate of 75 tons a day of acetylene, or 27,000 tons a year. It is believed that acetylene will be produced at a lower cost from processing our natural hydrocarbons than by the high temperature electric furnace method. The natural gas industry of the United States produced in 1942 about 3,000,000,000,000 cubic feet of gaseous hydrocarbons, part of which could supply the whole world with acetylene and its derivatives.

Thiokol is manufactured from ethylene derived from the cracking of oil, chlorine and sulfur, whereas the Buna-S rubber is produced from styrene from coal and petroleum, and butadiene derived from grain alcohol and petroleum.

Butyl rubber is based upon the chemical reaction of isobutylene, butadiene or isoprene.

We are being geared to produce synthetic rubbers in the following tonnages:

	Tons per year
Buna-S	845,000
Butyl	132,000
Neoprene	69,000
Thiokol	60,000

The world's natural rubber production for 1941 was 1,675,000 long tons, of which the United States imported 820,000 tons. With the tremendous number of airplanes, tanks, motor trucks, ships, trains, gun mountings, etc., the rubber demands are ever increasing, not alone for the fighting forces on the far-flung fronts, but for the necessary war work behind the lines. A statement appeared a few days ago that ground tanks were passé due to the fact that the heavy guns of the United States were able to smash them. If this be so, then airplane tanks heavily armored for low altitude flying should be the answer, and this will call for increased quantities of rubber. Medium size tanks require 500 pounds of rubber and pontoon bridges over 1,000 pounds. The gasoline tank alone of a Flying Fortress uses 500 pounds of bullet-sealing rubber, while large bombers require over 1,200 pounds. Gas masks use three fourths of a pound, while battleships use between 75,000 and 150,000 pounds. Excavation trucks used by the Army with tire diameters of nine and one half feet require about 3,500 pounds. There are many hundred more products requiring rubber that are vital in the war effort, such as blimps and barrage balloons. The latter have not been used in the United States to any extent. However, if the war reaches our shores tremendous quantities of rubber will be needed for this purpose. Rubber boats, rafts, safety vests and suits for flyers, hospital rubber requirements, etc., are also some of the products demanded from the rubber industry.

Ironically, press dispatches from the Far East indicate that the Japanese are cracking rubber to produce gasoline and other oils, which is an indication that they have a shortage of oil despite the fact that they have taken over the Far Eastern oil fields of the Netherlands and the British. As a contrast, in the United States we crack petroleum to produce synthetic rubber and gasoline.

You may well ask the question: Is synthetic rubber equal to the natural? One may say, the synthetic product is at least equivalent to the natural, but as of to-day it does not duplicate it, nor is it essential to duplicate nature's product, for the chemist's goal is

to produce rubber with far superior properties to the natural. It has already shown far superior properties from the standpoint of gasoline, oil and chemical resistance. The synthetic product has greater wearing properties, and does not deteriorate readily in sunlight and air.

A number of trucks and motor cars using synthetic rubber have gone over 35,000 miles, and one may reasonably expect at least 100,000 miles with the amount of research going on in the laboratories of the United States. The greater general strength of a synthetic tire means less driving hazards and far better road gripping. The latter property has been thoroughly tested on wet and muddy roads. Hill tests made with a number of trucks on a muddy road showed that the synthetic-tired vehicle had very little side-slipping, while the natural-tired vehicle slipped all over the road. Taxicab drivers advise that they all feel far safer in driving in mud or on wet city streets when their cabs are tired with synthetic rubber.

The research laboratories of the United States have discovered at least three thousand synthetic rubbers of varying properties. Some of them are exceedingly expensive to produce and others relatively low priced. One may state that synthetic rubber for tires will be highly competitive with the natural rubber, and in mass production synthetic should be less than 15 cents a pound. Natural rubber has sold through the years at prices varying from 3 cents to $3.00 per pound.

We are in a rubber crisis which may mean that all motor vehicles not used in the war effort will cease operating in order to be sure that all our fighting fronts will have sufficient rubber for ultimate victory.

Synthetic rubber must be provided at the rate of at least 1,100,000 tons a year called for by the Baruch Committee. Never again should the United States be caught short of rubber, whether in war or peacetime.

AVIATION DEVELOPMENTS

Scientific, technical and industrial miracles are taking place throughout the United States, not the least of which is in the airplane industry. In a few years production of airplanes has stepped up from less than 1,000 per year to over 48,000 in 1942, with 100,000 projected for 1943. It is not solely a question of the number of planes but their design, quality and size based on incorporating the knowledge gained on the fighting and research fronts.

Extraordinary strides have been made in the fabrication of airplane engines, propellers and bodies. The materials of construction are now of aluminum, magnesium and their alloys, stainless steel, plywood and plastics. These will be highly competitive after the war. Aluminum alloy forgings for cylinder heads stepped up the horsepower of the engines 15 per cent. as well as decreasing its weight. Seversky reported that a 32,000 horsepowered airplane was in the making, using four 8,000 horsepower engines. A Flying Fortress, the U. S. Army B–19, is an 8,800 horsepower airplane, with a 36,000 pound high explosive carrying capacity. In contrast, "Air Jeeps" of 65 to 100 horsepower are in our fighting forces on the Pacific and African fronts. They are used for fighting since they carry Stokes mortars and heavy machine guns, as well as 100-pound bombs, and have a range up to 500 miles with an altitude averaging about 1,000 feet. They are also used for observation in place of the old-type balloons, for courier duty, auxiliary scouts and as advanced guards by the striking forces. In peacetime these planes were the well-known Piper Cubs, Aeroncas, Taylor Crafts, Fairchilds and Stinsons.

The giant strides made by the airplane industry are at least matched by the oil industry in producing the 100 and higher octane gasoline and the necessary lubricants to operate the hundreds of thousands of aviation engines.

There are many chemical processes involved in the production of our aviation gasoline. The 100-octane gasoline is a 100 per cent. development of the oil industry of the United States. We have far superior aviation gasoline and lubricating oils than the Axis powers have available. The octane ratings of aviation gasoline which were collected from shot-down German planes averaged about 87. It has been reported that the German invasion of England in September, 1940, was stopped by the R.A.F. because their fighting planes were powered with 100-octane fuel, while the German planes were fueled with 87-octane.

The importance of high octane ratings in gasoline for airplanes is strikingly shown in the performance of 87-octane compared to 100 in a bombing plane, particularly as to speed, rate and time of climbing to maximum ceilings and maneuverability of the plane. Comparative tests of 87- versus 100-octane in a bombing plane showed that it took nineteen minutes to reach an altitude of 26,000 feet for 87-octane, whereas the 100 required only twelve minutes. The absolute ceiling of the plane in round numbers was 37,000 versus 33,000 feet for the lower octane-fueled plane.

The newest transport plane, called the Constellation, just tested, will carry fifty-two passengers with a speed greater than the Japanese Zeros. The plane can fly at about a seven-mile ceiling far above storm conditions, while ordinary cruising altitudes are about four miles. The Constellation can cross our continent in one eight-hour hop using more than 8,000 horsepower with the remarkably low fuel consumption of one gallon of gasoline per mile.

CONCLUSION

World War II may not be a total loss for humanity. A tempo never before attained in the United States has been reached with a collaboration and exchange of knowledge between heretofore highly competitive groups. New materials now in war production will have great peacetime values. We will also have access to a vast amount of knowledge and experience which has been accumulated as the result of hectic years of war. Man's life will be prolonged, his health, mentality, imagination, and productivity increased, and the pain and irritations of life will be reduced to a minimum.

OBITUARY

OSKAR BOLZA

NEWS has recently reached mathematicians in America through the American Red Cross that Oskar Bolza passed away peacefully in Germany on July 5, 1942, at the age of eighty-five years. He emigrated to this country in 1888, was one of the founders of the Chicago Section of the American Mathematical Society and a member of the National Academy of Sciences, and had great influence on the development of mathematics in America during his residence here from 1888 to 1910.

He was born on May 12, 1857, in Bergzabern in the Palatinate of the Rhine. The fortunes of his family were considerable, due to the exploitation in 1817 of an invention of a rapid printing press by his maternal great-great-grandfather, Friedrich Koenig. So far as is known he was free throughout his life from financial worries. In 1873 his father, who had retired from his position in judicial service, moved his family to Freiburg-im-Breisgau, and from that time this city was Professor Bolza's German home city to which he returned for a part of almost every year.

As a young student Bolza was interested primarily in languages and comparative philology. But in an academy at Neuchatel under a Frenchman named Terrier, and in the Gymnasium at Freiburg under a professor named Koch, he studied what we would call college mathematics. Both of these men were inspiring teachers, and Bolza's experience with them became decisive for his whole life. His enthusiasm for mathematics grew to be a dominant one, while his interest in languages took a secondary position.

At the University of Berlin, which Bolza entered in 1875 at the age of eighteen, it soon became evident that he would be much more interested in a scientific career than in the family printing press factory which had long been managed by two of his uncles. After some hesitation over theoretical physics he decided in 1878 to devote himself to pure mathematics. Due to his own conscientiousness, and probably partly to his financial independence, his university student career was a long one. He studied at the University of Berlin under Kummer, Kronecker and Fuchs, and notably under Weierstrass in the famous course on the calculus of variations which Weierstrass gave in 1879. This course proved to be perhaps the most potent influence in forming Bolza's mathematical interests, though his doctor's dissertation was written in a different field. In other years he studied at Göttingen under Schwarz and Klein, and his dissertation on the reduction of hyperelliptic to elliptic integrals was finally approved by Klein in 1888. His examination for the Ph.D. was successfully passed in the same year when Bolza was twenty-nine years old.

The problem of a profession was a serious one for Bolza. Two of his intimate student friends, the mathematician Heinrich Maschke and the physicist Franz Schulze-Berge, had both reluctantly taken positions as gymnasium instructors. There did not seem to be opportunities in Germany for the three friends as lecturers in a university. Bolza had been rejected for military service because of his rather delicate physique and he dreaded the twenty hours a week of teaching required in a gymnasium. Fortunately at this stage, in 1887, Schulze-Berge came to the United States and promptly secured a position as an assistant in Thomas Edison's experimental laboratory. His enthusiastic recommendations and the persuasiveness of two American professors, M. W. Haskell and F. N. Cole, who were then students in Göttingen, decided Bolza to take a chance in the New World. In April, 1888, he joined his friend Schulze-Berge in New Jersey, and shortly thereafter he was appointed reader in mathematics at the then youthful Johns Hopkins University. A year later he was appointed "associate" at Clark University, which opened its doors for the first time on October 1, 1889.

Clark University had been founded as a graduate school. In a few years it had financial difficulties which led to unhappiness and dissension in the faculty, as a result of which a number of them were quite ready to accept positions at the still newer University of Chicago which opened on October 1, 1892. Bolza was invited to join this group and he persuaded President Harper of the new university and Professor E. H. Moore, the head of the department of mathematics, to appoint both himself and Maschke as associate professors, Maschke having meanwhile also come to the United States. Bolza took up his new duties on January 1, 1893, and after one year was made a

full professor, in accordance with an earlier agreement.

The combination of Moore and Bolza in analysis, and Maschke in geometry, was a strong one at the University of Chicago. The university became at once one of the leading graduate schools of mathematics in America and its students are widely scattered in the departments of mathematics of American universities. Many of us owe our interest and training in mathematics to Bolza in particular, though every one who studied at Chicago at that time must also have been greatly influenced by Moore and Maschke. They were all three most able scholars and skilful lecturers.

In 1908 Maschke died, and the Chicago environment became a very sad one for Bolza. Their friendship from student days had been an ideal and very intimate one. This sadness, together with the fact that his mother in Freiburg was very old and seemed to have at most a few years more to live, were undoubtedly most influential in deciding Bolza to return to Freiburg permanently. But he himself has said that he was also much influenced by the feeling that by that time there were many younger men well trained in mathematics in America, and that he should make way for some of them. He was also interested to find that he would be appointed at the University of Freiburg to an honorary professorship which would permit him to lecture on mathematics as much or as little as he desired. So in June, 1910, after eighteen years at the University of Chicago, Bolza was appointed non-resident professor of mathematics there and returned to Germany with, as he himself wrote, "warm feelings of thanks and admiration for this country, which at a critical time in my life had given me the opportunity to develop my possibilities and follow my inclinations."

As honorary professor at the University of Freiburg Bolza continued at a moderated pace his lectures on a variety of mathematical subjects and his mathematical research. In the summer quarter of 1913 he lectured again at the University of Chicago and renewed with great pleasure his friendships in America. The first world war of course disturbed him greatly and in the end cut short his research activity in mathematics. In 1922 at the age of sixty-five he gave up his mathematical research, and in 1926 he interrupted his lectures at the University of Freiburg.

At this time he became interested seriously again in languages, especially Sanskrit, and in religious psychology. In the latter field he published a book entitled "Glaubenslose Religion" under the pseudonym F. H. Marneck. It was an absorbing interest during the latter part of his life.

He had one last return to his lectures on mathematics at the University of Freiburg during the years 1929–1933 and then gave them up finally at the age of seventy-six. Just about that time one of his earlier and most intelligent Ph.D. students, J. H. McDonald, of the University of California, visited him for several weeks in Freiburg. A result of this visit was a renewed interest in the theory of the transformation of hyperelliptic to elliptic integrals. Bolza wrote and published in 1933 on this subject his last mathematical paper.

Bolza's principal mathematical interests were in the reduction of hyperelliptic integrals to elliptic integrals (eight papers), elliptic and hyperelliptic functions (seven papers), and the calculus of variations (twenty-eight papers). In these fields, and others of lesser interest to him, he made important contributions. In the calculus of variations especially he has been a most notable contributor, and his principal book on the subject, entitled "Vorlesungen über Variationsrechnung," published in 1909, is an example of the finest scholarship, indispensable to every one interested in the field.

Thus has passed a potent figure in American and European scholarship, a brilliant lecturer and a man beloved by his students and colleagues. At the suggestion of one of his former students he wrote and published privately in 1936 an autobiography of about forty-five pages entitled "Aus meinem Leben." It is a most interesting document, now in the hands of many of his mathematical students. From it was taken much of the material in the preceding paragraphs.

G. A. BLISS

RECENT DEATHS

DR. CARL C. BRIGHAM, professor of psychology at Princeton University, died on January 24, at the age of fifty-two years.

DR. GEORGE BORIS KARELITZ, professor of mechanical engineering at Columbia University, known for his work on lubrication, died on January 19 at the age of forty-eight years.

DR. JOHN RATHBONE OLIVER, formerly professor of the history of medicine at the Johns Hopkins University, died on January 21, at the age of seventy-one years.

DR. WINFORD LEE LEWIS, inventor of lewisite gas, until 1924 professor of chemistry and head of the department at Northwestern University, later director of the Scientific Research Institute of the American Meat Packers Association, died on January 20. He was sixty-four years old.

WILLIAM MASSEY CARRUTH, for twenty-six years Samuel F. Pratt professor of mathematics at Hamilton College, died on January 23, at the age of sixty-three years.

DR. HERMANN JOHANNES BOLDT, emeritus professor of gynecology of the New York Post-Graduate School of Medicine of Columbia University, died on January 13, at the age of eighty-six years.

DR. JAMES MARSHALL BRANNON, assistant professor and assistant chief in dairy bacteriology at the College of Agriculture of the University of Illinois, died on January 21, at the age of sixty years.

SCIENTIFIC EVENTS

MICROFILM RECORDS OF THE LINNEAN COLLECTIONS AND MANUSCRIPTS

THE Carnegie Corporation of New York in April, 1941, made a grant to the Linnean Society of London to enable that organization to prepare a photographic record of all the extant Linnaean natural history specimens, and the Linnaean manuscripts in the possession of that society. After surveying the possibilities, the council of the Linnean Society decided to have microfilm records made. In making its appeal for a grant, the council of the society agreed to deposit a complete set of the proposed photographic records in some American institution. It has actually exceeded this condition in that after the microfilm records were made, two sets of positives were delivered to the Arnold Arboretum, each containing about 60,000 exposures. The ultimate plan is to deposit complete or partial sets in selected European and Colonial institutions.

The council of the Linnean Society selected Harvard University as the place of deposit of one set and directed the delivery of the second set to the Smithsonian Institution. Thus two American institutions benefit through this action of the Linnean Society and through the generosity of the Carnegie Corporation in making a grant to cover the cost of preparing this extensive microfilm record.

The Harvard University set, in so far as it appertains to botany, will be deposited at the Gray Herbarium, and the remainder at the Museum of Comparative Zoology. The second set has been delivered to the Smithsonian Institution. A very extensive series represents all the specimens in the Linnaean Herbarium, while other rolls represent the insects, molluscs and fishes in the Linnaean collections. An even larger part of the microfilm record represents Linnaean manuscripts and his published texts wherein he had made corrections and additions.

Arrangements will ultimately be made whereby specialists in other institutions may be able to have access to this most important record. All biologists realize the fact that the Linnaean collections are absolutely basic to the binomial system of nomenclature and that in order to interpret various Linnaean species it is essential that his material be examined, either the original specimens or photographic records of them.

E. D. MERRILL

ASSETS OF THE UNIVERSITY OF MICHIGAN

ASSETS of the University of Michigan amounted to \$83,014,263 for the fiscal year ending June 30, 1942, according to the annual financial report of Shirley W. Smith, vice-president and secretary, which has been approved by the University Board of Regents.

This year's total is an increase of \$3,054,708 over last year, with the greatest rise shown in current assets—cash, including restricted expendable gifts, student loans, inventories, etc., which jumped \$1,258,281, and plant and endowment funds which rose \$848,928 and \$683,379, respectively.

The total value of the educational assets, including lands and buildings, this year is \$59,972,085, a rise of \$823,988. The increase was largely in equipment and buildings whose value rose \$384,119 and \$323,404, respectively, over the figures for 1941.

The increase of \$105,454 in lands is due to the purchase of the site for the Rackham Memorial Building in Detroit, partially offset by the sale of property in Ann Arbor, various transfers and reallocations. Increase in the amount for buildings is due principally to the completion costs of \$175,582 for the Rackham Building in Detroit and initial construction costs of \$143,615 for the School of Public Health Building.

Current operating income of the university was listed at \$12,100,716, which includes \$2,452,334 hospital receipts, or 20.27 per cent. of the total amount. State appropriations of \$4,972,084 were the chief items of income, amounting to 41.09 per cent., while student fees amounted to \$2,292,199, or 18.94 per cent. The only other appreciable item of current income is the total of \$1,328,089 in gifts and grants for current use, or 10.97 per cent. of the total. The four other receipt items were each less than five per cent.

The current operating expenditure reached \$10,702,896 this year, with the outstanding item of expense being \$4,974,710 or 46.48 per cent., for instruction, followed closely by the University Hospital, which cost \$2,420,522, or 22.61 per cent. of the grand total. Only one of the other nine items of expense

stands out, that being the operation and maintenance of the physical plant at a cost of $987,970, or 9.23 per cent. All other expense items are each less than 6 per cent. There remained, however, fairly large unexpended amounts of gifts and grants for purposes restricted by the donors.

University trust funds increased $1,662,012 over last year's total, with the total figure listed at $20,399,040, as compared with $18,737,028. Endowment funds in the hands of the university were $13,179,025, and in the hands of the state treasurer, $550,744, with an additional $2,130,700 in trust. The increase in endowment funds is largely due to the $400,000 Horace H. Rackham Fund addition, the original gift amounting to $4,000,000. Student loan funds were $687,836, agency and deposit funds amounted to $1,778,404, and expendable funds were $2,072,330.

THE WAR-TRAINING CENTER OF NEW YORK UNIVERSITY

NEW YORK UNIVERSITY has transformed its 50-acre campus at University Heights into a war-training center for engineering, science and related activities. Plans are now in operation, according to Chancellor Harry Woodburn Chase, to expand and consolidate war-training efforts through the establishment of a coordinated program to be directed by Dr. Thorndike Saville, dean of the College of Engineering. Courses in the University College of Arts and Pure Science, under Dean William B. Baer, will give right of way to students preparing for vital war service. Such portions of its program as can no longer be cared for at University Heights will be continued at the Washington Square center for the duration of the war.

The teaching staff and technical facilities of the engineering college are being called upon to train increasing numbers of cadets and enlisted men of the Air Corps in meteorology, to conduct specialized classes for various other branches of the military forces, and to give intensive courses for the personnel of war industry. Furthermore, preparations are being made to accept additional men in uniform who are likely to be sent for training in engineering, science and pre-medical studies.

To meet the directives of the War Manpower Commission it is equally important to maintain the training of regular undergraduate and graduate students in engineering, and those enrolled in pre-medical, predental and science majors. These programs will be continued. The organization at University Heights will enable activities to be coordinated, and will provide for some 2,500 full-time day students.

In addition evening classes will be conducted for about 1,500 civilians under the program sponsored by the Government for war training in engineering, science and management. There will be at least 800 regular degree students in the evening and graduate divisions. During the second semester it is expected that nearly 5,000 students engaged in studies directly concerned with the war will be trained.

A research program in the technological as well as the pure sciences engages the facilities of every department. The wind-tunnels of the Guggenheim School of Aeronautics, as well as the laboratories in other branches of engineering science, are now being utilized for wartime research.

A new mess hall for the use of Army and Navy personnel is being constructed. Facilities will be available for the complete housing, feeding, drilling and training of the men.

The Washington Square College of Arts and Science, despite its own emphasis on war work, will maintain a full liberal arts curriculum. Its special war courses include cryptography-cryptanalysis, radio communications, foreign languages and the basic and pre-professional sciences required by the armed services.

In addition to the concentration of war work at University Heights, the downtown center at Washington Square will offer programs related to the war in the fields of education, liberal arts and business, as well as in public service. Dean Charles Maxwell McConn will supervise the arts and science curricula, which in the second semester will offer an accelerated program for entering men and women freshmen which will enable them to complete their degree requirements in two years and eight months; a one-year pre-induction course for seventeen-year-old male freshmen; an accelerated pre-medical and pre-dental program, and evening pre-induction war service courses.

The School of Commerce, Accounts and Finance, under the direction of Dean John T. Madden, will add to its regular business curriculum on February 1 an intensive six-weeks evening program for men and women seeking war work and for others already employed who want to improve their skills.

AWARD OF THE RESEARCH COUNCIL ON PROBLEMS OF ALCOHOL

THE Research Council on Problems of Alcohol has announced an award of $1,000 for "outstanding research on alcoholism during 1943." The work must contribute new knowledge in some branch of medicine, biology or sociology important to the understanding or prevention or treatment of alcoholism. Citizens of the United States, Canada or Latin America are eligible for the award.

The project may have been inaugurated at any time in the past or during the year 1943, provided (a) that a substantial part of the work be carried on during the year 1943; (b) that it be developed to a point at which significant conclusions are possible before the

end of the year, and (c) that a report on the work has not been previously announced and described before a scientific body or previously published. It is desirable, but not necessary, that those planning to work for the award send to the council before March 1, 1943, a statement of such intention. A report of the work and resulting conclusions must be submitted to the Research Council on Problems of Alcohol on or before February 15, 1944.

The Committee of Award will consist of five members—an officer of the American Association for the Advancement of Science, and four representatives of the Scientific Committee of the Research Council on Problems of Alcohol.

If the committee is not convinced of the outstanding merit of the research done during 1943, as described in reports submitted, it may, at its discretion, postpone the award for another year, or until such time as work of such merit has been performed.

THE NEW YORK MEETING OF THE OPTICAL SOCIETY OF AMERICA

THE mid-winter meeting of the Optical Society of America will be held at the Hotel Pennsylvania in New York, N. Y., on March 5 and 6. The Inter-Society Color Council will meet on Thursday, March 4, for a discussion in the morning and a business session in the afternoon. On Friday morning, March 5, there will be held a symposium of invited papers on "Vision" as follows:

"Factors in Human Visual Resolution," by Gordon L. Walls, Bausch and Lomb Optical Company.

"Some Physiological Aspects of the Eye as an Image-Forming Mechanism," by Kenneth N. Ogle, Dartmouth Eye Institute.

"Dark Adaption: Some Physical, Physiological and Clinical Considerations," by Charles Sheard, The Mayo Foundation.

"Some Factors and Implications of Color Constancy," by Harry Helson, Bryn Mawr College and The Foxboro Company.

An informal dinner will take place in the evening, followed by a lecture on "Visual Processes and Color Photography" by Ralph M. Evans, of the Eastman Kodak Company.

A second symposium on "Color-Blindness and Color-Blindness Tests" (arranged by the Inter-Society Color Council) will be held in the morning of March 6. The subjects of the papers and the authors are:

"Facts of Color-Blindness," by Deane B. Judd, National Bureau of Standards.

"Methodology of Test Preparation," by Forrest Lee Dimmick, Hobart College.

"The Evolution of Color Vision Tests," by Elsie Murray, Cornell University.

"The Red-Green-and-Yellow Equation for Normal and Color-Blind Observers," by Selig Hecht, Simon Schlaar and James C. Peskin, Columbia University.

"Hue Discrimination Test for Anomalous Color Vision," by David L. MacAdam, Eastman Kodak Company.

"A Method of Testing Color Vision Using Colored Transparencies and Standard Conditions of Observation," by Frederick W. Jobe, Bausch and Lomb Optical Company.

"The Farnsworth-Munsell 100-hue and Dichotomous Tests for Color Vision," by Dean Farnsworth, New York University.

"The ISCC Single Judgment Test for Red-Green Discrimination," by LeGrand H. Hardy, Institute of Ophthalmology.

Contributed papers will be presented in the afternoons of both days.

ELEMENT NO. 85

RECENT press dispatches from Bern, Switzerland, report the identification of element 85 as a disintegration product of radium. The work was done by Dr. Walter Minder, director of the Radium Institute at Bern, and Dr. Alice Leigh-Smith, an English expert in nuclear physics who has been studying cancer at the institute. Among the disintegration products of radium, these workers found traces of a compound which appeared to contain a radioactive form of element 85. Their recent work has succeeded in increasing the amount available, and now the announcement is made of the photographic identification of the element. The name anglo-helvetium is proposed in honor of England and Switzerland.

It will be recalled that the discovery of element 85 was announced in 1931 by Professor Fred Allison, of the Alabama Polytechnic Institute. By using the magneto-optic apparatus he found traces of the element, which he named alabamine, in sea water, in samples of potassium bromide and in such minerals as kainite, apatite and fluorite.

SCIENTIFIC NOTES AND NEWS

DR. A. W. HULL, of the General Electric Company, has been elected president of the American Physical Society in succession to Dr. P. W. Bridgman, Hollis professor of mathematics and natural philosophy at Harvard University. Other officers elected were Dr. Arthur J. Dempster, of the University of Chicago, *vice-president;* Dr. Karl K. Darrow, of the Bell Telephone Laboratories, *secretary,* and Dr. George B. Pegram, of Columbia University, *treasurer.*

PROFESSOR G. W. STEWART, of the State University

of Iowa, was presented with the Oersted Medal at the New York meeting of the American Association of Physics Teachers, which was held in conjunction with the American Physical Society. The medal is given for eminence as a physics teacher.

THE Robert M. Losey Award of the Institute of Aeronautical Sciences has been conferred on Commander F. W. Reichelderfer, chief of the U. S. Weather Bureau, "in recognition of his outstanding contributions to the science of meteorology as applied to aeronautics."

IN a recent issue of SCIENCE there was a note stating that Dr. Eugene L. Opie had returned to Cornell University Medical College to take charge, in the absence of Dr. William Dock, who recently entered the Army, of the work of the department of pathology. Dr. Opie is devoting part time also to the Henry Phipps Institute, Philadelphia, as temporary director of the laboratories.

A VICTORY ship of the California Shipbuilding Corporation has been given the name of George E. Hale, the distinguished astronomer who died in 1938.

DONALD BERTRAND TRESIDDER, M.D., president of the Board of Trustees and an alumnus of Stanford University, has been appointed to succeed Dr. Ray Lyman Wilbur, who was elected president in 1916. Since June, 1941, Dr. Wilbur has been chancellor and acting president of the university.

DR. GAYLORD P. WHITLOCK, who received the Ph.D. degree in agricultural and biological chemistry at the Pennsylvania State College in December, 1942, has joined the research staff of the department of dairy industry at the Iowa State College at Ames.

DR. MARGARET H. FULFORD, assistant professor of botany at the University of Cincinnati, has been appointed the recipient of a summer fellowship established for one year through a gift of Mrs. Elon Huntington Hooker. The fellowship was given to perpetuate the memory and work of Dr. Marshall A. Howe, who was for thirty-five years a member of the staff of the New York Botanical Garden and for the last two years of his life its director.

DEAN IVAN C. CRAWFORD, of the College of Engineering of the University of Michigan, has been named technical adviser and consultant to the Training Division of the U. S. Navy. Dean Crawford's services are being loaned to the Navy. He will return to the university a few days each month to carry on his administrative work in the College of Engineering.

DR. E. E. NAYLOR, assistant professor of botany at the University of Missouri, has become a technical assistant on the staff of the New York Botanical Garden.

GLENN L. MARTIN, president of Glenn L. Martin Company, has been elected president of the Aircraft War Production Council. He succeeds Guy W. Vaughan, head of Curtiss-Wright Corporation.

S. CAPLAN, who for the past nine years has been associated as research chemist with the Harvel Research Corporation, has become the research manager and acting technical director of the Irvington Varnish and Insulator Company at Irvington, N. J. He succeeds C. F. Hanson, who has been appointed chief consulting engineer. He will be responsible for expediting technical work on war production.

DR. MAURICE L. TAINTER, professor of pharmacology at the Stanford University School of Medicine, has been named state gas officer for California by the State Council of Defense Emergency Medical Service. Dr. Tainter set up San Francisco's gas treatment and protection services for civilian defense.

DR. HAROLD T. COOK, plant pathologist at the Virginia Truck Experiment Station, Norfolk, Va., has been commissioned Lieutenant in the Navy Reserves.

DR. WILLIAM B. HERMS, professor of parasitology and head of the Division of Entomology and Parasitology of the University of California, has been called to active duty by the War Department as Lieutenant-Colonel in the Sanitary Corps. He has been a Reserve Officer since 1924 and has been called for duty at the Army Medical Field Service School, Carlisle Barracks, Pennsylvania. He will be instructor in tropical medicine, having specialized in work on malaria, typhus fever and other diseases of the tropics. Professor E. O. Essig, professor of entomology, will act as head of the division during Professor Herms's absence.

DR. J. STANLEY GARDINER, F.R.S., emeritus professor of zoology at the University of Cambridge, has been appointed a member of the British Standing Commission on Museums and Galleries in the room of the late Sir Henry Miers, F.R.S.

ROBERT RAE, professor of agriculture at the University of Reading, England, and joint director of the Agricultural Research Institute at Hillsborough, Ireland, is visiting the United States. He will make a study of agricultural colleges and field organizations.

JOHN H. PIERCE left New York on January 12 on a wartime assignment to Colombia, Venezuela and Brazil for the Pan-American Products Corporation. He will collect and make a survey of certain plant products that are needed in war production.

THE sixth Christian Fenger Lecture of the Institute of Medicine of Chicago and the Chicago Pathological Society will be delivered on February 8 by Dr. William H. Taliaferro, Eliakim Hastings Moore distin-

guished service professor of parasitology and dean of the Division of Biological Sciences of the University of Chicago. He will speak on "Antigen-Antibody Mechanisms in Immunity to Metazoan Parasites."

DR. O. D. VON ENGELN, professor of geology at Cornell University, gave the Bownocker lectures of the department of geology at the Ohio State University on the afternoons of January 21 and 22. He also addressed the Ohio State Chapter of the Society of Sigma Xi on the evening of January 21. The subjects for the afternoon lectures were "The Nature of Glaciers" and "Two Schools of Geomorphology." The subject for the evening lecture was "Terrain and War."

DR. JOHN L. RICE, president of the American Public Health Association for 1942 and formerly commissioner of health of New York City, has joined the staff of Lederle Laboratories as consultant.

PROFESSOR CARL G. HARTMAN, of the department of zoology of the University of Illinois, spoke on January 13 at Iowa State College on "Instinctive Behavior."

AS announced last year two symposia are being organized by the American Physiological Society: "Special Senses in Relation to War Problems" by Dr. Hallowell Davis and "Physiological Aspects of Fitness in Relation to War Problems" by Dr. Maurice B. Visscher. These will be published in the second and third numbers of "Federation Proceedings" with similar material from other societies. It is not planned to have them orally presented at any regional meeting.

THE Johns Hopkins Medical History Club will hold its second meeting of the year on Monday, February 1, at 8:30 P.M., in the Institute of the History of Medicine. A paper on "Superstition and Medical Progress" will be given by Dr. E. B. Krumbhaar, of the University of Pennsylvania, and one on the "History of our Knowledge of the Lymphatic Vessels," by Dr. George W. Corner, of the department of embryology, Baltimore, of the Carnegie Institution of Washington.

THE next meeting of the trustees of the Elizabeth Thompson Science Fund will be held in April. Previous awards from the fund were reported in SCIENCE on June 19 and earlier. Applications for grants should be made to the Secretary, Dr. Jeffries Wyman, Biological Laboratories, Harvard University, Cambridge, Mass.

THE Supreme Court on January 18 upheld the conviction of the American Medical Association and its affiliated Medical Society of the District of Columbia on charges of seeking to restrain the operations of the Group Health Association, Inc., a Washington medical service cooperative, in violation of the Sherman anti-trust law forbidding restraint of trade. The indictments accused the two medical organizations of seeking to restrain the cooperative in supplying—through monthly salaried full-time employee doctors—medical care to its members and their dependents; to restrain members of the Group Health Association from obtaining such medical care; to restrain Group Health Association doctors; to restrain other doctors in the pursuit of their calling and, finally, to restrain Washington hospitals.

A NEW editorial board has been announced for *Endocrinology,* its members being J. S. L. Browne, department of medicine, McGill University; E. T. Engle, College of Physicians and Surgeons, Columbia University; Carl G. Hartman, department of zoology, University of Illinois; E. C. Kendall, Division of Biochemistry, Mayo Clinic; F. C. Koch, department of biochemistry, University of Chicago; C. N. H. Long, department of physical chemistry, Yale University School of Medicine, and H. B. van Dyke, Squibb Institute for Medical Research. The managing editor is E. B. Astwood, of the departments of medicine and pharmacology, Harvard Medical School, and the associate managing editor, E. W. Dempsey, of the department of anatomy also of Harvard Medical School. A statement of new policies for the journal appears in the February issue of *Endocrinology.*

A RESEARCH fellowship in the department of chemistry at Lehigh University has been established by the West Vaco Chlorine Products Corporation to support research into the uses of active magnesia particularly as a catalytic agent. The grant, which carries a monthly stipend to the student of $60, has been guaranteed for two years and begins with the new semester on February 1. The work will be under the direction of Dr. Albert C. Zettlemoyer, instructor in physical chemistry.

THE J. T. Baker Chemical Company has announced that its Eastern Fellowship for Research in Analytical Chemistry is open for 1943–44. The object of this fellowship is to encourage and to assist fundamental research in analytical chemistry. The recipient will receive $1,000 annually and will be expected to devote at least nine months to research in an institution conferring the Ph.D. or Sc.D. degree in chemistry in New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia or one of the New England States. The fellowship is awarded by a committee consisting of N. H. Furman, *chairman,* Princeton University; J. H. Yoe, *secretary,* University of Virginia; G. P. Baxter, Harvard University; H. A. Fales, Columbia University, and M. L. Nichols, Cornell University. A candidate for this fellowship must

possess a bachelor's degree or its equivalent and a broad training in the fundamental branches of chemistry. Applications should be sent to John H. Yoe, University of Virginia, Charlottesville, Va., not later than March 1. Further details will be furnished upon request.

THE London correspondent of the *Journal* of the American Medical Association writes: "The war has cut off the Scandinavian sources of material for making paper, and the supply of paper for the printing of periodicals and books is controlled by the government. The result is enforced economy in the consumption of paper. The first June issue of *The British Medical Journal* in 1941 contained only thirty-eight reading pages; in the corresponding issue of 1942 the number was reduced to thirty-two because the paper controller continues to cut the supply. Hence *The British Medical Journal* has made a further reduction in the size of the type and reduced the considerable space given to correspondence, and has enjoined conciseness on correspondents."

ATTENTION is called in a note printed in *Nature* to the extensive facilities available at the Imperial Institute, London, for the rapid supply of technical information relating to the trade, occurrence and utilization throughout the world of all kinds of raw materials, and the scope of the intelligence service is not so well known as they should be. The institute's staff includes tropical agriculturists, chemists, chemical technologists, economic botanists, economic geologists, mining engineers, mineralogists and statisticians, and, when desirable, the institute seeks the advice of members of its fifteen consultative committees. Further help is also afforded by numerous trade contacts. The institute also has an extensive reference library and a technical index covering most of the relevant trade and scientific publications issued during the past thirty years. The institute can deal with inquiries relating to sources of supply of, and other information relating to, raw materials and semi-manufactured products whether of animal, plant or mineral origin in all countries, cultivation of crops and the soil and conditions under which they have to be grown, methods employed in mining, smelting and dressing minerals for the market, and so on. Analysis and testing of samples of raw materials is undertaken in the laboratories of the institute. Inquiries should be made in the first instance to the Intelligence Section of the Plant and Animal Products Department or of the Mineral Resources Department, according to the nature of the subject concerned. No charge is made for services to departments of the United Kingdom Government or other Governments of the Empire contributing to the general funds of the institute unless a particular inquiry involves a volume of work so great that it can not be undertaken by the existing staff.

DISCUSSION

EFFECTS OF THE EARTH'S ROTATION ON THE RANGE AND DRIFT OF A PROJECTILE

THERE has been much discussion recently concerning the question: Does a projectile (or missile) move farther when fired to the east than when fired to the west? Some authors contend that the two distances traversed are the same, others that the distance to the east is greater than that to the west, and still others that the distance to the west is greater than that to the east.

Under the proper restriction each of these statements is correct. For, as we shall show below, if the angle of elevation of the gun were *just* 60° the two distances would be the same; if it were between 0° and 60° the distance to the east would be greater than that to the west, and finally if this angle were between 60° and 90° the distance to the west would be greater than that to the east.

In order to prove this, use will be made of some of the formulae which have already been derived by the author in his monograph entitled, "The Weight Field of Force of the Earth," published in Washington University Studies, New Series, Science and Technology, No. 11, 1940.

1st Proof: By a simple trigonometric transformation the second of formulae (129) on page 68 the range x of a projectile may be expressed in the form

$$\bar{x} = \frac{v_0^2}{g_1} \sin 2\beta + \Delta\bar{x}, \tag{1}$$

where

$$\Delta\bar{x} = -\frac{4 v_0^3}{3 g_1^2}\omega \cos \phi_1 \sin 3\beta \sin \alpha,$$

in which ω is the angular velocity of the earth's rotation with respect to the fixed stars, g_1 is the acceleration, due to weight, at the position of the gun, ϕ_1 is the astronomical latitude at the position of the gun, α is the azimuth (measured from the south through the west) of the direction of fire (*i.e.*, of the positive sense of the axis of x), β is the angle of elevation of the gun (measured upward from the direction of fire), v_0 is the muzzle velocity of the projectile. The ranges in value of the various angles are:

$$-90° < \phi_1 < 90°, \qquad 0° \leqq \alpha < 360°, \qquad 0° < \beta < 90°.$$

If the projectile be fired to the east, for which $\alpha = 270°$ or $\sin \alpha = -1$, we have, in particular,

$$\Delta\bar{x} = \frac{4\,v^3_0}{3\,g^2_1}\omega \cos \phi_1 \sin 3\,\beta \begin{cases} > 0 \text{ for } 0° < \beta < 60°; \\ = 0 \quad \text{''} \qquad \beta = 60°, \\ < 0 \quad \text{''} \; 60° < \beta < 90°, \end{cases}$$

with the positive sense of x to the east.

If the projectile be fired to the west, for which $\alpha = 90°$ or $\sin \alpha = 1$, we have, in particular,

$$\Delta\bar{x} = -\frac{4\,v^3_0}{3\,g^2_1}\omega \cos \phi_1 \sin 3\,\beta \begin{cases} < 0 \text{ for } 0° < \beta < 60°, \\ = 0 \quad \text{''} \qquad \beta = 60°, \\ > 0 \quad \text{''} \; 60° < \beta < 90°, \end{cases}$$

with the positive sense of x to the west.

In both of these cases the *deviation in range* (*i.e.*, $\Delta\bar{x}$) extends to the east if $0° < \beta < 60°$, and to the west if $60° < \beta < 90°$, and this deviation is zero if $\beta = 60°$. The first term in formula (1), namely: $\sin 2\,\beta \cdot v^2{}_0/g_1$, represents distance from the gun to the east if $\alpha = 270°$, and to the west if $\alpha = 90°$. It is from the terminal points of both of these distance-vectors that $\Delta\bar{x}$ extends to the east if $0° < \beta < 60°$ and to the west if $60° < \beta < 90°$, and produces no augmentation if $\beta = 60°$. We have thus proved the statements made in the second paragraph.

2nd Proof: Let us refer the motion of the projectile to a set of cardinal axes $0 - \xi, \eta, \zeta$ of which the origin 0 is at the muzzle of the gun, and the positive senses of the axes of ξ, η, ζ are to the south, east and zenith, respectively. Denoting the time derivatives of the coordinates ξ, η, ζ by ξ', η', ζ', respectively, the components of the muzzle velocity-vector (v_0) are $\xi'_0, \eta'_0, \zeta'_0$. Again referring to the above mentioned monograph, we find that equations (115), on page 63, express the coordinates ξ, η, ζ of the moving projectile in terms of the time t. If we equate to zero the expression for the altitude ζ and solve the resulting equation for t, we obtain the expression (123), on page 66, for the time of flight of the projectile. Substituting this value of t in the first two equations (115), we obtain for the coordinates of the *point of fall*, the expressions

$$\bar{\eta} = \frac{2\,\eta'_0\zeta'_0}{g_1} + \frac{4\,\omega}{g^2_1}\,[\zeta'_0\{\eta'^2_0 - \tfrac{1}{3}\,\zeta'^2_0\}\cos\phi_1 - \xi'_0\zeta'^2_0 \sin\phi_1],$$

$$\bar{\xi} = \frac{2\,\xi'_0\zeta'_0}{g_1} + \frac{4\,\omega}{g^2_1}\eta'_0\,\zeta'_0\,[\xi'_0 \cos\phi_1 + \zeta'_0 \sin\phi_1].$$

If, in particular, the line of fire is along the east-and-west line (*i.e.*, along the axis of η), we have $\xi'_0 = 0$, and then the preceding formulae become

$$\bar{\eta} = \frac{2\,\eta'_0\zeta'_0}{g_1} + \frac{4\,\omega}{g^2_1}\{\eta'^2_0 - \tfrac{1}{3}\,\zeta'^2_0\}\,\zeta'_0 \cos\phi_1,$$

(2)

$$\bar{\xi} = \frac{4\,\omega}{g^2_1}\eta'_0\,\zeta'^2_0 \sin\phi_1.$$

Since now (*i.e.*, for $\xi'_0 = 0$) we have $\eta'_0 = v_0 \cos\beta$, $\zeta'_0 = v_0 \sin\beta$, (where β may now be regarded as measured from the positive η-axis and capable of ranging in value from $0°$ to $180°$, so as to include the case in which $\alpha = 90°$ as well as that in which $\alpha = 270°$), the first of formulae (2) becomes the same as formula (1) when $\alpha = 270°$, and the second takes the form

$$\bar{\xi} = \frac{4\,v^3_0}{g^2_1}\omega \sin\phi_1 \cos\beta \sin^2\beta,$$

which is the same as the expression for the drift (distance of the point of fall from the line of fire) given by the third of formulae (129), page 68, of the monograph, for the special case in which $\alpha = 270°$ or $90°$.

The first of formulae (2) gives us the information we desire. For since $\zeta'_0 > 0$, it follows that the first term changes sign with η'_0 (since it enters to the first degree), whereas the second term *does not* change sign with η'_0 (since it enters to the second degree). Furthermore, the second term is positive, negative or zero according as

$$\eta'^2_0 - \tfrac{1}{3}\,\zeta'^2_0 = v^2_0\,(\cos^2\beta - \tfrac{1}{3}\sin^2\beta) = v^2_0\,(1 - \tfrac{4}{3}\sin^2\beta)$$

is positive, negative or zero, *i.e.*, according as the angle of elevation β is less than, greater than or equal to $60°$.

WM. H. ROEVER

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SUGGESTED CASTE TAXONOMY FOR THE COMMON TERMITE

FOURTEEN years have passed since the beginning of the work of the Termite Investigation Committee under Drs. C. A. Kofoid and S. F. Light, of the University of California. Early in the work, good fortune permitted my selecting as a subject of study the genus *Reticulitermes* with a caste system, more complex than that of any other wide-spread Nearctic genus of termites. I used, of course, the regular caste taxonomy of the time. Primary, secondary and tertiary reproductives were each studied as a caste. But long-time collecting yielded a series of specimens bridging the gap between the primary reproductive and the worker; the supplementary reproductives, far more prolific than the primary, gradually assumed, in a new line of thinking, the status of an intercaste. Nanoids, both soldiers and workers, were found, and at first were recorded as castes; then rare intermediate soldier-workers and still rarer soldier-reproductives had to be classified. At last I came to feel that we who are interested in the complicated society of the termitarium might be "picking castes from the air." Independent work since has extended my laboratory observations to include the chief species of *Reticulitermes* in each of the termite-yielding sub-regions of the Nearctic. I find that given sufficient time, we can produce or at least predict the appearance of most of the outstanding forms found in the labyrinths. This brought not a "break with the old system" but a gradual drifting away from it. What I regarded as a caste, fourteen years ago, may now seem no more than subcaste or intercaste; instead of listing newly discovered sizes and forms, each in a separate caste, it seems better to seek to relate each to one of the three more common castes: Reproductives, workers

and soldiers. Interblendings of these and maturity attained in different instars by different individuals would seem to account for all other forms and sizes, remembering, of course, the absence of nasutes in *Reticulitermes*. In *South Carolina Natural History* (No. 29, 1937) the existence of intermediates and subcastes is indicated, but I did not feel free to break completely with the idea of supplementaries and nanoids as castes. In *Neighborhood Research* (2: 3, 1938) I am inclined to treat secondary, tertiary and soldier-like reproductives as well as soldier-workers as intermediates of the three regular castes, and in the same publication (4: 1, 1940) I have outlined the scheme of classification of castes I am still using in my study of *Reticulitermes,* save for the substitution of what seem better names for some of the forms observed. Thus all forms have been found capable of relation to this classificatory scheme:

CASTE 1. Primary, primitive or archaic reproductives; the "king and queen" or "royalty" of older writers. Fully winged previous to mating and thoroughly pigmented.

Intercaste 1. Supplementary reproductives; "vice-royalty"; "secondary" and "tertiary" reproductives; brachypterous and apterous reproductives; neoteinics. Most of the forms here will be found to be the white "brachypterous" type. The older lines are too hard and fast; a gradual transition in form may be traced from the primary reproductive to what is apparently the worker form. We should here include all below the perfectly winged type and all above the infertile worker, in a broad reproductive-worker intercaste.

CASTE 2. Workers; ergatoids. Wingless individuals who do the labor. They are found in four sizes, which have been termed sub-castes:

- i. Midgets, or Nanoids, apparently adult at fifth instar
- ii. Dwarfs, or Parvuloids, apparently adult at sixth instar
- iii. Regulars, or Megaloids, apparently adult at seventh instar
- iv. Giants, or Gigantoids, apparently adult at eighth instar

Intercaste 2. Worker-soldier or soldier-worker form. Known, so far only in the midget, and perhaps the dwarf form, but only one size positively known. Thus division into sub-intercastes is not justified. For sake of a different initial in graphs I have called this intercaste form the *guerrilla,* which word bears a suggestion of the diminutive, or at least the "small-time" warrior.

CASTE 3. Soldiers; guards. Fighters, who are unable either to reproduce or to work. They occur in the four sizes, or subcastes, given above for workers.

Intercaste 3. Reproductive-soldier or soldier-reproductive. Known so far only in a larger size corresponding to the regular-sized or perhaps the giant-sized soldier or worker. I have termed this a *tiro,* following the Latin and Austin Dobson's spelling of the word, which originally signified a newly levied soldier, or beginner. It really seems to be the last of the known forms to make its appearance, and its tyro—using the common spelling—nature shows in its being both soldier and reproductive but doing neither well.

Let us take now the initial letter of each of the names given to castes and intercastes, *viz.,* A from the alate or better the archireproductive caste, N from the "neoteinic" or better the neoreproductive intercaste, and so: W, worker; G, guerrilla; S, soldier, and T, tiro, with E for the egg-mass deposited during the entire history of the community. Arrange them thus:

	A	
T		N
	E	
S		W
	G	

Some individuals hatching from E the egg-mass will develop through about seven stages to become alates, the youthful archireproductives. Many more will develop through five to eight stages or instars toward W to become workers. A smaller number, through a similar number of instars, grow toward S to become soldiers. Now can any one believing in the modern scientific ideas suppose that the eggs of the ancient roach-like termite following a normal course and producing individuals that developed along a straight course, which we may readily visualize as an unserifed, or Gothic, capital I, thus normally growing into reproductives like their parents, at some time suddenly began following some strange V-shaped path into reproductives and soldiers, and in later and higher termites an equiradiate Y into reproductives, soldiers and workers? Such a theory smacks too much of some force leading the insects along the mystic Pythagorean monad, duad and triad, shaped respectively like Gothic I, V and Y. Whether they arose by saltations or more gradual development true castes must have reached their more distinct forms through a line of intermediates more nearly like the primitive ancestors than appears at a later time. One group of these intermediates has proved so successful a deviation that most of the work of reproduction is carried on by it, and the primitive form has assumed a sort of secondary role in the matter of egg-laying.

In the rise and decline of a common termite community, each caste, intercaste and subcaste has apparently a place and time for its appearance approximating the exactitude with which dramatic players come

upon the stage for their parts. At swarming time the alates emerge, dealate themselves, sometimes after, sometimes without flight, and after pairing off and constructing a small cell begin a primary community. In *Reticulitermes* the diminutive nanoid worker is usually the first form to be distinguished as an offspring of one of these pairs. Soon after, however, we expect a nanoid soldier, and in those groups in which they appear the soldier-workers or "guerrillas" in nanoid size are due about the same time. In isolated groups there may be a delay in the arrival of new forms and sizes for even two years. Fortunately, however, several of these families may be neighbors, since the alates swarm often by thousands and rarely fly very far. A struggle now begins which we can liken only to a small war of imperialism. A number of parents may be killed off by invasion and their offspring annexed to a larger group headed by a surviving pair of reproductives. With more communal feeding parvuloid and megaloid workers and soldiers appear in order. The guerrillas or soldier-workers disappear, and with a larger population none of the soldiers nor workers become adults in the earlier instars, and so midget and dwarf forms yield to the larger sizes, and in very old and populous groups some appear to retain a sort of perpetual youth and to grow into an eighth instar, so becoming giants or gigantoids. But before this group arises the population has grown sufficiently to enable it to support a number of short-winged potential reproductives. I have found these within three years and six months from the time of the establishment of the original cell by the dealated primaries. Six months later, or four years after the spring in which the community began its history, the first swarm of alates issued, the cycle having worked back to the same form that established the said community. The soldier-reproductive or tiro remains unaccounted for. Apparently these arise from small groups of workers cut off from the main body and left without brachypterous potential reproductives. If we carefully hand-pick under the microscope a group of wingless workers and set them apart in a separate termitarium we may expect after a long period, as much even as ten months, a wingless or almost wingless reproductive to arise. At times, however, in such a group or perhaps in a remote part of the labyrinth a juvenile with a tendency toward the soldier form is apparently transformed into the reproductive before any worker can be so transformed. It is the rarest of the regularly recognized forms, and seems to occur only in one of the larger subcaste sizes. Note this carefully. While the soldier-worker or *guerrilla* is to be expected in the low populations of young and growing communities and in a smaller subcaste size, the soldier-reproductive or tiro is rather expected in the low populations of old and decadent communities and in a larger subcaste size. It would probably take years of experimenting, but it would be interesting to place the eggs of young primaries in these old, decadent groups to see if any of the resulting young developed into the reproductive-soldier form. Incidentally, it is quite likely that such eggs placed in a highly populous colony would not produce any of the lower subcastes, but that the young would grow into a larger size before becoming definitive workers or soldiers. Are guerrilla and tiro mere size variations or subcastes of the same form generations apart? At present, it seems better to regard these two intercastes as separate forms, both perhaps almost vestigial in *Reticulitermes,* but in a more primitive genus, *Zootermopsis.* Prof. G. B. Castle has found a number of fertile soldiers, the females capable of producing eggs, the males with large and well-developed testes (Kofoid and Light, "Termites and Termite Control," 1934). Some of the more tropical genera, still higher in development than *Reticulitermes,* have produced what I am inclined to regard as a fourth caste, the nasutes. Incidentally some nasutes have lost the mandibles, while on one hand others have long soldier-like mandibles, and on the other hand some have short mandibles that may relate them to the workers. Such genera it has not been my privilege to study closely in life, and I make the suggestion, merely as a possible explanation of the origin of the nasutes, worth at least a thought. Was the intercaste between the worker and the soldier which plays so little a part in the *Reticulitermes* group as to generally disappear early in the history thereof, retained in more advanced genera to be developed into other forms?

Anthropomorphism long troubled the zoologist; apimorphism still troubles the student of castes; too long he has been bee-minded. Apparently the worker-bees can make conditions that result in a "queen," but the termite reproductive evidently yields some secretion that inhibits the normal sex-development of its associates and keeps them in the condition of workers. Remove the reproductives, and others arise, which in turn secrete an inhibiting substance, that continues to hold the less forward individuals in the energetic but unfertile condition. As the colony grows, many succeed in wandering to parts of the labyrinth where they are free from this influence and so develop into normal reproductives. This increase of population, with more abundant intra-communal feeding, also allows the development of larger sizes of subcastes previously mentioned.

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A RECORD OF EMERITA ANALOGA FROM THE WASHINGTON COAST

DURING the spring and fall of 1941 and the summer of 1942 numerous sand crabs, *Emerita analoga* (Stimpson), were collected from the ocean beaches of Washington from the mouth of the Columbia River north to Kalalock. The localities include Long Beach, Grayland Beach, Copalis Beach and Kalalock Beach. They appeared to be especially common at Kalalock. Beaches north of the last locality have not been examined. The specimens ranged in size from postlarval stages with the carapace length of about 4 mm, to ovigerous females with a carapace length of 28 mm. Two male specimens collected were 11.5 and 13 mm long. The measurable characters of the specimens collected were well within the range of variation given by Schmitt.[1]

This species has never before been recorded north of Oregon, where it was reported from unspecified localities by Holmes.[2] Schmitt (*loc. cit.*) reports specimens in the U. S. National Museum from Drake's Bay, California, to San Bartolomé Bay, Baja California, in the northern hemisphere and from Peru to Chile in the southern.

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THE MICROMETER BURETTE

ARGUMENTS about priority are perhaps stupid and always embarrassing, but I regard the micrometer syringe with particular jealousy. I feel that the authors of the article entitled "Micrometer Burette" in SCIENCE, 96: 247, 1942, should have given a reference to the paper in the *Biochemical Journal*, 19: 1111, 1925, in which I described for the first time the application of the principle of their apparatus to biochemical work. The usefulness of the principle is emphasized by the number of times it has been redescribed with minor modifications both in England and America since I wrote the paper referred to.

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SCIENTIFIC BOOKS

ALCOHOL ADDICTION

Alcohol Addiction and Chronic Alcoholism. Vol. I. *Effects of Alcohol on the Individual.* Edited by E. M. JELLINEK. Pp. 336. Yale University Press. New Haven, 1942. $4.00.

THIS first volume of a series of three to appear under the auspices of the Research Council on Problems of Alcohol presents by six authors, including the editor, a survey and analysis of the literature, with the declared purpose of clarifying the subject-matter as a basis for future research and for reference purposes.

The etiology and treatment of alcohol addiction are first received, the bulk of the book being then devoted to a description of some of the mental and bodily diseases of chronic alcoholism.

Some idea of the mass of material represented can be had from the statement of the editor that about 3,500 references among an estimated 100,000 bearing upon the topics of the projected three volumes were found to be worthy of consideration, because they were neither obsolete from the point of view of the medical sciences of 1941, nor primarily of propagandist character, nor were compilations producing no original opinions, nor duplicate presentations of already published data, and because they did deal with the effects of alcohol on the individual.

While there can be no precise distinction between the effects of alcohol on the individual and those related to his behavior or condition in society, the editor assures us that the "sociological aspects of inebriety" are not excluded from present consideration but only "'the effects of inebriety on society." In spite of the lack of any exact definitions of inebriety or of society as intended and used, it is fair to say that the spirit of the above distinction is followed in the half dozen chapters.

"Generally the scope of this work is the etiology of abnormal drinking; the effects of such drinking on the bodily and mental functions of the individual; and the immediate effects of alcohol in any quantity on the organs and their functions, and on psychological behavior." So far so good, but one searches in vain for the considered opinion of an author or the editor as to when drinking moves from normal to abnormal and what is the range of "normal" or "psychological" behavior in the user of alcoholic beverages. In both the Preface and in the introductory pages by the editor, there is a dearth of precise expressions but much language which leads to uncertainty of meaning. We are told that, in dealing with certain types of original articles, "the reviewers were justified in ignoring the verbalized conclusion of the investigator."

[1] *Univ. of Calif. Publ. Zool.*, XXIII, 1921, p. 173.
[2] *Calif. Acad. Sci. Occ. Papers*, VII, 1900, p. 103.

Physiologists, we are told, since they came to the problems of alcohol "from the theoretical frame of reference of physiology," have rarely made "longitudinal studies, which are prerequisite to the understanding of the process of addiction."

The following statement of attitude may be accepted as the editor's rather than that of the clinician authors. "On the whole, physiology, experimental psychology and clinical medicine have produced basic data, and psychiatry has furnished the necessary insight and working hypotheses, sufficient to warrant application of the existing knowledge to the investigation of the essential and complex problems of the origins of inebriety and addiction, their prevention and treatment." And this is the last the reader hears of prevention of alcohol addiction, of alcoholism or of abnormal drinking.

Part One, with two chapters by Karl Bowman and the editor on "Alcohol Addiction and its Treatment," and "Alcoholic Mental Disorders," and the related twenty pages of bibliography, is less effective or convincing as a source of facts and opinions of the past than are the four chapters of Part Two, perhaps because of the nature of the topics, but apparently more for the reason that the authors of chapters three to six express convictions based largely on direct personal knowledge of the current facts.

It is perhaps a merit in a reviewer to suppress his own views in giving the lessons of his predecessors, but something of definiteness could certainly have been said in regard to the etiology of alcohol addiction, even if its treatment remains the happy hunting ground of striking personalities and hopeful endeavorers. One gathers the impression that the etiology of alcohol addiction is clouded in a deepening obscurity.

Surely the clinical and time factors or criteria for "cure" of the alcohol addict are no more difficult to establish than are those for cancer or toxic hyperthyroidism, and yet we are left to flounder among tables of obviously non-comparable data in our efforts to discover any objective evidence of the results of various plans of treatment. One could wish the authors of Chapter I had expressed a bit of their own thoughts in the matter and spared us some of the confusion they reveal. We are told in substance only that more and better studies are needed and that effective psychotherapy must be made available to much larger numbers of addicts.

Chapter II is good, the topic lending itself to reasonably precise and accepted points of differential diagnosis and description. The field of alcoholic mental disorders has been tilled by men of acumen, imagination and wide experience and the gist of their facts and opinions is well presented.

Nowhere else than in Chapters III to IV of Part II can one find in medical literature in such convenient form, or so authoritatively expressed, the background, the present status and the immediate direction of further study of the topics dealt with.

Evidence, observation, critical discussion and conclusions are all admirably presented by Dr. Norman Jolliffe and his colleagues, the late Dr. Herman Wortis and Dr. Martin H. Stein, and by Dr. Giorgio Lolli. (III. Vitamin Deficiencies in Chronic Alcoholism, IV. Alcoholic Encephalopathics and Nutrition, V. Marchiafava's Disease, VI. Cirrhosis of the Liver.)

Here at least we are on a sound foundation, the meeting ground of clinician, pathologist and biochemist. Only in part of the last chapter on "Cirrhosis of the Liver" do we meet a rather inadequate and crude use of the statistics of morbidity and mortality. The usual techniques of correlation have not been used and there have been ignored some factors of tabulation, registration practice and incompleteness of reporting of deaths attributed to any form of alcoholism which certainly affect the validity of original data and the comparability of international death rates.

The undertaking of the three volumes is one of great difficulty, complex, little short of encyclopedic and beset by pitfalls in both fact and opinion. This first product of the Council's efforts shows courage and imagination. Volume II will deal largely with experimental material and the highly controversial matter of "germ damage." Volume III will deal with "the magnitude of the problem in terms of incidence, and will analyze the statistics presented in the literature."

Might the devotee of administrative medicine and public health enter a plea for a Volume IV to be devoted to evidence of changes in incidence of and mortality from acute and chronic alcoholism and in consumption of alcohol per capita, related directly or by inference to administrative measures of civil or military governments affecting the production and drinking of beverage alcohol, and some consideration of the actual cost to society of the burden of the alcoholic.

HAVEN EMERSON

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OCEANOGRAPHY

Oceanography for Meteorologists. By H. U. SVERDRUP. xv + 246 pp. New York: Prentice-Hall, Inc. 1942. $3.50.

IN the solution of certain scientific problems and in carrying on of essential practical work, meteorologists connected with the present war have had an important share, as is evident from the repeated call of the United States Government for qualified persons in this field. A number of excellent meteorological texts have recently appeared to satisfy the needs of professionals and students alike. The book before us,

however, is of a different type because it is fundamentally on oceanography designed to aid the meteorologist in securing information bearing on problems of the atmosphere which physical oceanography can furnish. In this respect the volume fills a need not adequately met by any other work known to the reviewer.

Sea-surface elements and processes which affect chiefly the atmospheric conditions receive especial emphasis. Included among these are the physical properties of sea-water, surface-currents and the processes which maintain them. Adequate discussion is accorded salinity, temperature, pressure, eddy viscosity and conductivity of sea-water as well as the observations and instruments for their determination. The heat-régime of the oceans requires particular treatment, including the effect of radiation to and from the ocean, exchange of heat between the atmosphere and the sea, and evaporation from the sea, all related in a complicated way to meteorological factors and their variations thereby affecting world weather conditions. Nearly one half of the text is devoted to a consideration of oceanic circulation and its various aspects—the water masses (counterpart of air masses) and the great oceanic currents which influence so profoundly the climates of the earth.

As the author remarks, "The theoretical discussion of the dynamics of the ocean currents and the factual information from many ocean areas are as yet incomplete, and therefore it may be premature to generalize. Nevertheless, it has been attempted to overcome difficulties arising from differences in interpretation of incomplete data by placing emphasis on application of the equation of continuity in the description of the ocean circulation."

The necessity of further expeditions to obtain oceanographic data is thus emphasized. The voyages of the *Challenger, Meteor, Carnegie* and other vessels have greatly broadened our knowledge of the ocean, both physical and biological, but it is to be hoped that, at the conclusion of the present conflict, new expeditions may be sent out to gather data which will fill the gaps in our knowledge of the oceans and settle outstanding problems regarding their relations with the atmosphere.

The book is attractively printed and provided with good text-figures. Four folding charts on Goode's homolosine equal-area projection exhibit surface temperatures of the oceans in February and in August, surface salinity in northern summer and surface currents in February–March. No bibliographical references are given other than a list of eleven outstanding general works at the end of the preface.

To meteorologists interested in the interrelations of their specialty with oceanography the volume may be recommended without reserve. The unique experience of the author in oceanographical and meteorological research, both practical and theoretical, which has earned international recognition, has eminently qualified him to make this contribution to geophysics.

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ORGANIC CHEMISTRY

The Work Book of Fundamental Organic Chemistry. By ED. F. DEGERING and COLLABORATORS. 250 pp. New York: Barnes and Noble. 1942. $1.25.

THIS is intended for review work in organic chemistry and self-testing on the material of the given short summaries: also for self-testing on the material of a year course in organic chemistry. Each chapter contains (a) a review summary; (b) genetic charts in which the more important reactions of typical compounds are emphasized; (c) nomenclature, pronunciation and formula tables; (d) a composite review summary; (e) fill-in review questions, and (f) one or more objective tests. It is a compilation having distinct usefulness for students who desire to excel in organic chemistry, but it seems to this reviewer to be too comprehensive even for the excellent student. No purpose is served by burdening the memory of students with such a mass of detail in review material. I can imagine an excellent student getting 100 per cent. in each test, piece by piece, after reviewing a chapter, but I can not believe that the most learned teacher of organic chemistry could get more than 80 per cent. *in toto* without previous concentrated study for some time. But surely the purpose of a review book for students should be selection of material likely to be a minimum for certain specific purposes.

Fundamental Organic Chemistry. By ED. F. DEGERING and one hundred and six collaborators. Photo-offset. Planographed by J. S. Swift Co., Inc. Cincinnati, Ohio.

A TEXT-BOOK of 485 pages, of which 88 pages are devoted to a "kaleidoscopic survey" of organic chemistry with stress in relative electronegativity. The chapters in this first section of 88 pages are headed with figures, male and female, to represent positivity and negativity with respect to each other, the four valences of the carbon atoms which these figures represent being shown by their arms and legs. Thus methyl ethanoate is represented by a particularly hectic moment in a jitterbug contest of two drunken sailors and a dame, other compounds varying in "hectivity." The tables are very lightly printed. The electronic formulae are very confusing and are introduced too often. Photographs of Fisher-Hirschfelder models are scattered profusely throughout, together

with projections of pin models. Each chapter is headed in very thick type, which contrasts badly with the lightly printed tables and makes for strain in reading. The amount of descriptive material is more than adequate for a year course but the publication as a whole includes much unnecessary information (*e.g.*, "a new neoprene plant at Deepwater, N. J., established by E. I. du Pont de Nemours and Company, began operation in 1939"), many unnecessary models, figures and electronic formulae, and is not appealing in format. The analogy of negativity with femininity is not allowable in a civilization now reputed to be well on the way to a matriarchy.

GARFIELD POWELL

SPECIAL ARTICLES

THE VERATRINE ALKALOIDS. XIV. THE CORRELATION OF THE VERATRINE ALKALOIDS WITH THE SOLANUM ALKALOIDS[1]

FROM studies to be published elsewhere, evidence has been accumulating which has caused us to propose revisions of the older formulations of a number of the alkaloids of *V. album, viz.*, jervine, rubijervine and germine, which had been considered to be C_{26} compounds, to $C_{27}H_{39}O_3$, $C_{27}H_{43}O_2$ and $C_{27}H_{43}O_8$, respectively, so that like cevine, also $C_{27}H_{43}O_8$, they are C_{27} derivatives. Also, evidence has been obtained which suggests that they are built up, if not on a regular, at least on a modified sterol structure.[2] The fact that they are probably C_{27} derivatives is at once most suggestive in this respect.

The alkaloids of the solanum species, such as the alkaloidal aglycone solanidine of potato shoots, appear to have been definitely correlated with the sterols. Thus from the solanidine derivative, solanidiene, on dehydrogenation with selenium, Soltys and Wallenfels[3] reported the formation of the characteristic sterol degradation product, methylcyclopentenophenanthrene. Rochelmeyer[4] confirmed this and at the same time recorded a similar observation with solasodine. In the last instance, there was also obtained a pyridine base which was characterized as a picrate (m. p. 140–142°). However, its identity or homogeneity was not established and no analytical data were given.

It has now occurred to us that this base could have been identical with the 2-ethyl-5-methylpyridine which we have found to be a characteristic degradation product of all the veratrine alkaloids. We have, therefore, repeated the investigation of the dehydrogenation of solanidine obtained from potato sprouts.

The volatile material which distilled when a mixture of 2.1 gm of solanidine and 6 gm of selenium was heated at 340° for 2 hours was separated into basic and neutral fractions. The former was fractionated in a microfractionating column 5 cm in length (Table 1).[5]

TABLE 1

Fraction	Bath temp.	Pressure mm	Wt. in mg of fraction	Micro b.p.	Analysis C	Analysis H
1	92°	30	30	171°	79.15	8.79
2	92°	30	40	173°	79.32	9.21
3	95°	30	40	176°	79.00	9.09
4	120°	13	30	186°	79.70	9.40

The micro boiling point of 2-ethyl-5-methylpyridine[6] is 171°. (Analysis: $C_8H_{11}N$. Calculated. C 79.27, H 9.15.)

A picrate prepared from fraction 1 melted at 142–144° (micro m. p.) and proved indistinguishable from the picrate obtained from the cevine degradation product. A mixed melting point showed no depression. (Analysis: $C_8H_{11}N \cdot C_6H_3O_7N_3$. Calculated. C 47.98, H 4.03. Found. C 48.21, H 3.91.)

The investigation of the much less volatile hydrocarbon dehydrogenation fraction is now in progress and will be reported at a later time. However, the isolation of ethylmethylpyridine in such good yield from solanidine, taken together with the fact that the veratrine alkamines, like the solanum aglycones, can be C_{27} compounds, makes apparent at once the close correlation of the two groups of alkaloids and, therefore, of the veratrine alkaloids with the sterols.

It may be pointed out in this connection that the recent interest[7] which has attached to the study of the cardiac action of veratrine recalls to mind that the digitalis compounds are not only unsaturated lactones but also sterol derivatives. This raises the question whether the cardiac action of both the cardiac glycosides and veratrine is not a property inherent in the sterol nucleus itself, once given the proper supporting groups in certain positions and the necessary stereochemical configurations.

LYMAN C. CRAIG
WALTER A. JACOBS

[1] From the laboratories of the Rockefeller Institute for Medical Research, New York.

[2] L. C. Craig and W. A. Jacobs, *Jour. Biol. Chem.*, 141: 253, 1941.

[3] A. Soltys and K. Wallenfels, *Berichte d. deutsch. Chem. Ges.*, 69: 811, 1936.

[4] H. Rochelmeyer, *Arch. d. Pharm.*, 274: 543, 1936; 275: 336, 1937.

[5] The microanalyses were made by Mr. D. Rigakos of this laboratory.

[6] W. A. Jacobs and L. C. Craig, *Jour. Biol. Chem.*, 124: 659, 1938; 129: 79, 1939.

[7] O. Krayer and R. Mendez, *Jour. Pharm. Exp. Ther.*, 74: 350, 1942.

THE SUCCESSFUL PRODUCTION OF A MAMMALIAN TUMOR WITH A VIRUS-LIKE PRINCIPLE

A METHOD has been developed whereby a powerful tumor-producing principle can be obtained from tumor tissue. Concentrations of a virus-like Berkefeld-passing factor have been produced which when injected subdermally in mice gave rise to tumors, the inception and growth of which were more rapid than that of implants of the donor cancer tissue.

The original tumor material consisted of mammary carcinoma tissue which had passed through more than 30 generations of transplants in dba mice where it initially appeared spontaneously. The tumors induced by the filterable factor were transplantable, rapid-growing and histologically were made up of malignant cells of carcinoma and sarcoma types.

Tumor development took place at the site of the injected material. Additional smaller growths have been found in the liver and in the visceral peritoneum of the digestive tract. There was, as would be expected, considerable variation in the rate of growth of the tumor in individual mice.

This investigation was begun about a year ago, at which time large numbers of eggs were being used in a study concerned with the effects of hypervitaminosis of some of the B vitamins on the growth and development of the chick embryo.[1] It occurred to the author that the yolk sac of the chick embryo might prove of value in demonstrating the possible existence of a virus-like principle as the immediate cause of tumors in general with particular reference to mammalian neoplasm. The successful growth of so many viruses in this medium was, of course, the basis for the idea.

In the meantime some thousands of eggs and more than 300 mice have been utilized on this problem.

Very early in the study, it was found that cell-free filtrates of yolk from chick embryo yolk sacs which had received an injection of tumor tissue a few days previously, contained a substance capable of inducing varying degrees of tissue hyperplasia when injected into a mouse. These growths developed rapidly, but after attaining 1.0 to 1.5 cm in diameter became stationary and then gradually regressed.

Similar growth stimulants could be obtained by injecting ground tumor cells and cell-free extracts of fresh tumor tissue into yolk sacs of chick embryos. It was found that yolk from eggs so treated could be passed by injection from yolk sac to yolk sac for many generations of chick embryos and still the yolk contained tissue growth stimulating substances.

Some months ago it was discovered that tumor tissue grows readily in the yolk sac of the chick embryo.[2] As more attention was given to this method of producing tumor tissue, it was noted that relatively large cancers, several grams in weight, occasionally occurred. Berkefeld filtrates of the yolk surrounding these large tumors contained the virus-like tumor-producing principle to a high degree. The evidence indicates that the tumor cells constantly gave off the virus substance which was caught and preserved by the surrounding yolk. Whether the tumor factor is able to grow independently in the yolk medium has not been definitely determined.

Briefly summarized, the method which proved successful is as follows: The yolk sacs of chick embryos were implanted, as previously described,[2] on the fifth day of incubation with saline suspensions of fresh tumor tissue. The eggs were then incubated for another 12 days, after which the yolk sacs were examined and yolk was collected from those bearing comparatively large tumors (a gram or more). Since the yolk at this time is very thick and viscous, saline solution was added in the portions of 1 to 1. The material was then centrifuged and the supernatant liquid passed through an N-size Berkefeld filter. Care was taken to keep all these operations aseptic. Dba mice were given subdermal injections ($\frac{1}{3}$ cc per mouse) of the filtrate so obtained.

The implications of the successful production of a mammalian tumor with a virus-like cell free product of tumor tissue will be obvious to workers in the cancer field. Certainly the hypothesis held by so many for so long that a virus-like principle is the primary cause of tumorous growths receives support.

There are grounds for hoping that the yolk sac method will prove useful in demonstrating the presence of a virus-like principle in other mammalian tumors and also in the many fowl tumors which have to date proved refractory in this respect. By utilizing eggs of fowls which have relatively long hatching period, it is hoped that this method of attack may be applied to human neoplasms.

A detailed report of methods and results will be given at an early date.

My sincere thanks and appreciation are due Dr. Roger J. Williams for the cooperation he has given me and for the interest and encouragement I have received from him throughout this research. My thanks are also due to my technical assistants, Juanita Thacker, Dorothy Pennington and Marguerite McAfee for their invaluable aid.

Alfred Taylor

The University of Texas,
Biochemical Institute, and the
Clayton Foundation for Research,
Austin

[1] A. Taylor, H. K. Mitchell and M. A. Pollack, Univ. of Texas Pub. 4137, 67, 1941.

[2] A. Taylor, J. Thacker, D. Pennington, Science, 96: 342, 1942.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

IMPROVED MAGNETIC FLOW SWITCH FOR USE WITH WATER-COOLED X-RAY TUBES

IN the flow switch previously described by me[1] the fit between the piston and the cylinder has a very small tolerance. If the clearance is too great, water may leak through from the intake port to the outlet port without lifting the piston; whereas if it is too small, mud, sand or other foreign matter may lodge in the upper part of the cylinder, fouling the piston so that it fails to drop when the flow of water ceases.

To overcome this difficulty the flow switch has been redesigned. In the new design the fit between piston and cylinder has a large tolerance and the water passing around the piston and through the cylinder constantly flushes the space between them, preventing the lodgment of foreign matter.

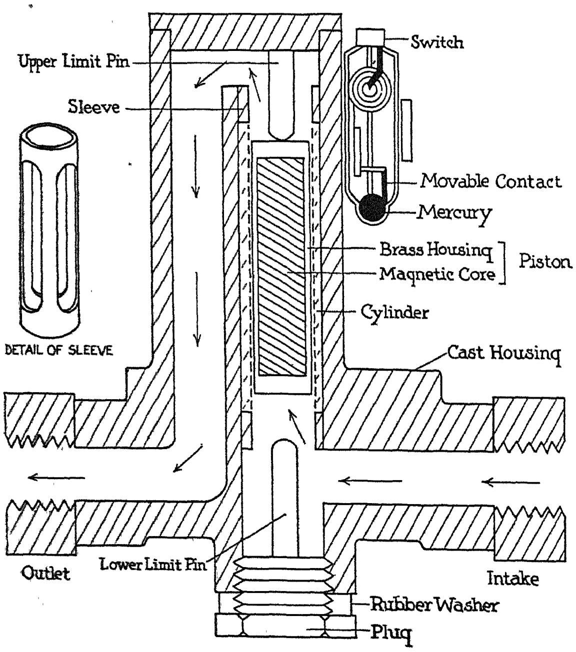

FIG. 1.

Fig. 1 shows the changes in the piston-cylinder assembly. The electrical and magnetic features are unchanged.

PAUL C. HODGES

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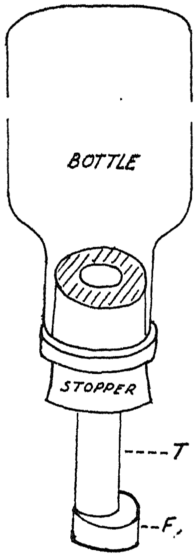
A LARGE FEEDER FOR SMALL CAGES IN AVIAN MALARIA STUDIES

THIS feeder (see sketch) allows access to a relatively large supply of clean seeds, enough to last one canary several days or weeks, depending on the size of the seed container.

[1] Paul C. Hodges, SCIENCE, 94: 424, October 31, 1941.

Particular considerations are that the diameter of tube "T" be wide enough and with its lower end high enough from the bottom of the feed cup to allow for easy passage of seeds; and that the feed cup "F"



allows sufficient space between its wall and that of the tube so the bird can readily but with restriction pick out the seeds.

ROBERT K. OTA
HARRY BECKMAN

MARQUETTE UNIVERSITY SCHOOL OF MEDICINE

BOOKS RECEIVED

A Collection of Articles and Essays on the Great Russian Poet A. S. Pushkin. Illustrated. Pp. 187. Mezhdunarodnaja Kniga.

ADELMANN, HOWARD B. *The Embryological Treatises of Hieronymus Fabricius of Aquapendente.* Illustrated. Pp. xxiii + 883. Cornell University Press. $12.00.

CHRISTENSEN, CLYDE M. *Common Edible Mushrooms.* Pp. x + 124. University of Minnesota Press. $2.50.

HAGAN, WILLIAM ARTHUR. *The Infectious Diseases of Domestic Animals.* Illustrated. Pp. xxvii + 665. Comstock Publishing Company. $6.00.

MERRIAM, JOHN C. *The Garment of God.* Pp. xii + 162. Charles Scribner's Sons. $2.00.

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SCIENCE NEWS

Science Service, Washington, D. C.

ANNUAL REPORT OF THE SECRETARY OF AGRICULTURE

LESS wheat, more meat; also more vegetables, eggs, dairy products, vegetable oils; steady on cotton and tobacco. This in a nutshell is the array of goals for American farmers in 1943, as summarized in the annual report of Claude R. Wickard, Secretary of Agriculture.

It is quite different from the agricultural aims of the last war period, when all the accent was on wheat. Ever since 1918, wheat has been produced in excess in this country, and with the war-caused total eclipse of export markets it has been piling up. The national carry-over as of July, 1942, was 633,000,000 bushels, to which the year's huge crop of about 984,000,000 bushels was added. The total is enough to meet all our bread needs for two years, even if no wheat at all should be harvested in the meantime.

In response to urgings of the department and the stimulus of reasonably good meat prices, farmers and stock raisers have built up their herds to new highs. The cattle population reached nearly 75,000,000 head a year ago, and despite heavy slaughter is being maintained. Pigs topped the hundred-million mark with five million extra to spare—enough for nearly five sixths of a whole hog apiece for every person in the country, except that we're sending part of our pork chops and bacon overseas to our armed forces and our fighting allies.

Use of some of our surplus wheat for feeding livestock and chickens is recommended by Secretary Wickard, so that we may increase supplies of meat, milk and eggs, all of which need to be maintained at the highest attainable levels.

An additional outlet for wheat is the international pool set up by the four great wheat-raising countries, the United States, Canada, Australia and Argentina, for the eventual relief of war-ruined countries. This pool now consists of 100,000,000 bushels, and is to be increased as need arises.

With a cotton surplus of more than 11,000,000 bales on hand, and the mills unable to spin it up much faster than they are doing now, increases in cotton production are not being encouraged. Instead, cotton farmers are asked to shift over to peanuts (for oil) in so far as possible, and also to substitute long-staple for short-staple varieties. Lower yields of the important co-product, cottonseed oil, are to be offset by increased production of other vegetable oils, notably soybean, flaxseed and peanut.

Tobacco stocks on hand are so large that no increase in acreage in this crop has been held justified, except in two types, flue-cured and Maryland, on which lend-lease requirements call for increases of about 10 per cent. over the 1942 figures.

The greatest possible emphasis is being placed on vegetable production, both by large-scale professional growers and home gardeners. Military and lend-lease shipments call for immense quantities of dehydrated vegetables, and an intensive drive for the 1943 Victory gardens will soon be under way.

SEEDLESS TOMATOES

TOMATOES can be induced to produce seedless, more solidly meaty fruits by treating the plants with the fumes of a growth-promoting acid, naphthoxyacetic acid, at or before the time the flowers open. Experiments along these lines, which may have important horticultural applications, were performed in the greenhouses of the great experimental farm of the U. S. Department of Agriculture at Beltsville, Md., by Dr. John W. Mitchell and Muriel R. Whitehead, of the Bureau of Plant Industry. Results will be reported in the forthcoming issue of *The Botanical Gazette.*

Use of growth-promoting chemicals to induce formation of seedless tomatoes and other fruits had already been reported by other investigators. However, their methods involved the use of sprays, or even the direct application of the substances to the flower-parts with brushes or by other hand means. Getting similar results merely by subjecting plants temporarily to self-distributing fumes from a few milligrams of the acid obviously saves a great deal of time and labor in the treatment.

In their experiments, Dr. Mitchell and Miss Whitehead placed a number of tomato plants in a closed chamber, so that the exact concentration of the fumes could be measured. They used 250 milligrams (1/120 troy ounce) of beta-naphthoxyacetic acid per thousand cubic feet of room space, evaporating it on a hot glass plate over an electric heater. After exposure to the fumes overnight, the plants were taken back to the greenhouse, where an equal number of untreated plants were placed with them for comparison purposes.

As the flowers opened, both treated and untreated plants were all carefully hand-pollinated. When the tomatoes were mature, they were compared for flavor, vitamins and total mineral content. Except for the fact that the tomatoes from the treated plants were nearly or quite seedless, no differences could be detected between the two lots.

THE STUDY OF WAR METALS

BY bouncing a beam of light off a tiny metal mirror, metals can now be observed changing into alloys and the rate at which metals diffuse through one another can be ascertained in a few minutes.

Developed by Dr. Howard S. Coleman and Professor Henry L. Yeagley, physicists at the Pennsylvania State College, the new method replaces tedious processes which took months and years. It helps to speed the study of war metals, just as other phases of the war program have been accelerated. New information will be obtained about improving alloys, the metal mixtures so important in the war. Studies may reveal more about the resistance of metals to heat and suggest ways of improving this quality. This same process might be used to prevent metal

corrosion. Fundamental things that occur in aging metals are being discovered.

Thin metal films only about a fourth the thickness of ordinary typewriter paper are being used. First, the metals are vaporized, then deposited on the top of one another as films on a glass slide, thus forming a mirror. They are then removed from the vaporization chamber, heated to the desired temperature and the diffusion rate observed.

The diffusion of these thin films usually occurs in a few minutes, compared to the many months often required by old methods which used larger quantities of metal. This also involved prolonged heating at a temperature of several hundred degrees while only slight heat is required by the new method. Sometimes even the heat of the hand is enough to start diffusion of thin films. To follow the speed of diffusion, the amount of light reflected from the mirror film is measured. A normal metal surface has a certain reflecting power. But as one metal spreads through another the amount of reflected light is changed. This change is measured by a recording instrument called a galvanometer.

TESTS OF PLANE ENGINES

MORE than half the power needed to operate an engine factory can be recovered from tests of plane engines, was reported by G. E. Cassidy, W. A. Mosteller and W. L. Wright, of the General Electric Company, at the New York meeting of the American Institute of Electrical Engineers.

The power-recovery method has helped the war effort by giving to the aircraft engine industry a testing technique that contains advantages not available in other methods. Testing can be done with greater ease and in less time on a basis that is economically sound.

Previous to the development of the new power-recovery system, energy produced during testing was dissipated by water brakes, propellers, electric brakes and other devices which involved complete wastage. Fuel consumed accomplished no useful purpose other than testing of the engine. Furthermore, engines became so huge that schemes to dispose of the power by wastage began to present difficult problems.

Starting with an inquiry for an improved method from Pratt and Whitney Aircraft, development of the power-recovery system has gone through several phases. Using an induction generator, one of the latest set-ups begins the test with a cold start and run-intest for checking mechanical operation and lubrication of the engine. Then speed is gradually increased. When ready to "fire" the ignition switch is turned on and the engine throttle adjusted to idling speed. As the throttle is opened, the generator speed passes through synchronism and load is automatically applied to the engine. Any desired values of load and speed can be established. From such a test, the engineers reported that 3,000 to 6,000 kilowatt-hours of energy may be recovered from each engine of current-large rating. It was pointed out that "the advantages of the power-recovery system applied to the testing of aircraft engines have not yet had time to be universally appreciated. It may be quite possible that with the passing of time the engine builder will point with more and more favor (toward wider use of the method) because he is already pointing toward larger aircraft engines—and the larger the engine the more advantageous power-recovery testing becomes."

SOURCES OF RUBBER

NOREPOL, the rubber-like material synthesized from soybean, corn and other vegetable oils by chemists of the U. S. Department of Agriculture at the Northern Regional Laboratory in Peoria, Ill., is now going into commercial production. Two companies are making it under trade names of their own, while others are producing it under the coined name given it by the department.

Norepol is a combination-word formed from the first syllables of NOrthern REgional POLymer. Technically it is a polymer of linoleic acid, one of the fatty-acid fractions of many vegetable oils. A polymer is a compound with big molecules, formed by welding together smaller molecules of other compounds. As a rule, polymers are "thicker," more solid, and harder or more elastic than the substances from which they are made.

Norepol, although rubber-like in its properties, is not a full substitute for rubber. It will stretch to only twice its normal length, instead of six times as in real rubber. Its tensile strength is only 500 pounds per square inch, as compared with 3,000 pounds or more. Nevertheless, it has good resistance to abrasion and aging and is impervious to water and alcohol, so that it can replace rubber in such uses as shoe heels, fruit jar rings, gaskets and tubing. Demand for norepol is estimated at 12,000 pounds or more for the current year. Since only the fatty acid from the oils is used in its manufacture, the other half of the oil compound, glycerin, is released as a co-product for the manufacture of explosives and other technical purposes.

Natural rubber from two other sources fostered by the Department of Agriculture is beginning to come in. More than 18,000 pounds of kok-saghyz roots have been harvested from the first experimental plantings, made possible by large shipments of seeds of this rubber dandelion rushed to this country from the beleaguered Soviet Union last spring, even while the Nazi armies were storming to new conquests. This harvest represents only a small fraction of the plants grown in many plantings over a large part of the country, to test the adaptability of the plants to American soils and climatic conditions. The greater part of the first year's crop has been left in the ground, to test the plants' over-wintering abilities in this country. In the meantime, labor-saving machinery has been worked out to harvest the first American-grown crop of seed.

It is emphasized that all the work thus far is experimental. No appreciable amount of dandelion rubber will be harvested in the immediate future, nor will any seed be available to farmers who may be thinking of growing the plant themselves.

The native American rubber shrub, guayule, is making a small beginning, on lands taken over from the Intercontinental Rubber Company by the U. S. Department of Agriculture. A mill operated by the U. S. Forest Service

at Salinas, Calif., will turn out 600 tons of guayule rubber this winter, using older shrubs that were already growing before Pearl Harbor. Plantations being established this winter are expected to yield about 21,000 tons from the harvest starting late in 1944. Further extensions will put the figure up to a maximum of about 80,000 tons. Although this is not much more than a tenth of the annual rubber requirement in this country, it will be distinctly helpful.

CAUSES OF LOST TIME AMONG SHIPYARD WORKERS

FLASH burns of the eyes and cinders or other foreign bodies getting in the eyes are among the most serious and frequent causes of lost time among workers in shipyards, was reported by Dr. Philip Drinker, of the Harvard School of Public Health, to the Congress on Industrial Health meeting at Chicago sponsored by the American Medical Association. The report was based on findings of a survey he and Dr. John M. Roche, serving as consultants on safety and health for the U. S. Navy and U. S. Maritime Commission, made of selected shipyards with government contracts in all parts of the country.

These eye injuries are obviously preventable, Dr. Drinker said, but he pointed out that ships are now being built in yards which cover very large areas with welding going on everywhere in them. It is very difficult to prevent flash burns of the welder's neighbors. The danger extends even to the experienced welder who lifts his shield momentarily and happens to be near another man welding.

A serious risk of lead poisoning also exists in the shipyards because of modern high-speed construction schedules. It is common shipbuilding practice to paint all metal surfaces as soon as possible with red lead. Generally this is done after the metal plates are in final position, but to keep fast construction schedules, some pieces are painted in the yards. Welding these painted surfaces brings the danger of lead poisoning, against which special care must be taken for workers' protection.

Special ventilation to control welding fumes is necessary for the men working on the fore and after plates and double bottoms where, because of prefabrication type of construction, the men must work in relatively small spaces.

Paint sprayers, their assistants and those working in the immediate vicinity require special protection. To make sure that the men are provided with efficient protective equipment, only such masks and respirators as have been approved by the U. S. Bureau of Mines may be used in shipyards with government contracts.

In general, Dr. Drinker found the medical and safety departments of the yards well organized and well run, although the high proportion of "green" workers complicates the safety problems. Many yards have as few as one or two per cent. of experienced men who had worked in shipyards before the war.

"We have been badly hit by the shortage of doctors in some districts, especially in rural communities," Dr. Drinker said, "but probably we are no worse off than many other industries. We doubt if our position in this respect represents any new problems."—JANE STAFFORD.

ITEMS

FOUR bushels of Cayuga soybeans, a variety developed by plant breeders at Cornell University, have been shipped to the Soviet Union through the Russian War Relief for trial plantings as a feed and food crop. Cool weather and short growing seasons in Russia resemble conditions of New York state. The Cayuga variety matures in any part of New York up to 1,600 or 1,800 feet elevation. Soybeans of the Corn Belt will not mature in New York or in the cool areas of Russia. The Cayuga's yield is from 20 to 25 bushels or more of dry beans to the acre.

BLACK cotton is a new variety recently originated by Russian plant geneticists, according to a bulletin of the Soviet embassy. One advantage which this cotton has, together with other varieties with colored lints ranging from reddish to green, is the eliminating of the dyeing process. It is believed that the natural black will be a faster color than the black of dyed cottons. American cottons with green and brown tints have been known for some time, but are not grown on a large scale because their yield is considerably lower than the white-linted varieties. Our colored cottons are used principally in certain regional handcrafts industries.

HOPES of greatly increasing vegetable and field crop yields through chemical treatment of seeds are somewhat damped by a report in *The Botanical Gazette*, on negative results of a large number of experiments by Dr. William S. Stewart and Charles L. Hamner, of the U. S. Department of Agriculture. A number of growth-regulating substances, including several commercial preparations intended for seed treatment, were tried on the seeds of a considerable assortment of plants, ranging from field crops like corn, wheat and soybeans to garden vegetables such as radishes, carrots and squashes. They were grown under a wide variety of soil and climatic conditions in three places—the Experiment Station at Beltsville, Md.; the University of Chicago, and Lake Geneva, Wis. In all cases, significant increase in yield as a result of the chemical treatment of seed could not be detected.

SOYBEANS are used to produce laminated board, valuable in aircraft and other war industries, in a new method announced by Dr. George H. Brother, of the Regional Soybean Industrial Products Laboratory of the U. S. Department of Agriculture. Sheets of unsized kraft paper or other fibrous material are soaked with a formaldehyde solution of soybean protein. After drying, stacks of these plastic sheets are united into laminated board by heat and pressure. This method promises to augment the nation's limited supply of high-priority phenolic resin now being used. Low water-resistance of the resultant board created a problem. Single sheets of the more waterproof phenolic resin placed on the top and bottom of the stack of soybean sheets before pressing, was the solution. Production of laminated board has been speeded by the new process, according to Dr. Brother, since pressing time for phenolic resin board is about five times as great as when soybean-protein-phenolic material is used.

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SCIENCE, AND ITS CHANGING SOCIAL ENVIRONMENT[1]

By Professor P. W. BRIDGMAN
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THE first part of this address dealt with recent work of the author in extending the pressure range attainable in the laboratory. The subject has been similarly treated in the third volume of Science in Progress, published by the Society of Sigma Xi.

And now I will turn from these technical matters, with which I have been personally concerned, to matters of more immediate and vital interest to all of us. In the present world struggle physics has come to occupy a position in the very front line. A large part of the body of physicists has been asked to divert its activities from accustomed channels, and all of us who have been able have rejoiced that the opportunity has been offered and that we can be of service. Because of the obvious importance of the service that physics is rendering, many physicists are anticipating, after the war, a permanent increase of the appreciation of the public for physics, and a great increase in the attractiveness of physics as a profession for our abler young men.

There are, however, other aspects of this rosy future to which I wish to direct your attention. Because of the heavy social impact of the products and techniques resulting from scientific investigation, there is a growing tendency in many quarters to maintain that science, and this of course includes physics, is the servant of society and that all scientific activities should be under complete supervision and control by society or the state. This point of view is finding advocates among scientists themselves. It seems to be growing in favor in some quarters in this country,

[1] Part of the retiring presidential address to the American Physical Society, given at Columbia University, January 23, 1943.

but not yet to the same extent as in Russia, where it is widely accepted, judging by various mass proclamations of Russian scientists published in our press, or in England, where there is an aggressive and articulate group with a similar attitude—the book by Bernal entitled "The Social Function of Science" comes to mind. Indicative of the feeling in some quarters in this country, there is an article in a recent number of the *Popular Science Monthly* which is an extreme example of this point of view. I believe that there is a probability that after the war this feeling will be intensified in proportion to the very success that physicists may have in helping to win the war.

Closely connected with the thesis that scientific activity is a social function is the growing impulse to hold the scientist personally responsible for all the consequences of his discoveries. In all this there is a good deal with which one may sympathize, but I believe that nevertheless an unqualified and unreserved acceptance of the current popular views about the social position of science will result in a false placing of emphasis which in the long run will be harmful both to scientists in their profession, including physicists, and to society as a whole.

The issue is confused by the looseness with which the word "science" is used. Popular usage lumps under the single word "science" all the technological activities of engineering and industrial development, together with those of so-called "pure science." It would clarify matters to reserve the word science for "pure" science. Because a single word is used, there is an impulse to assess a blanket responsibility and to set up blanket controls. Superposed on the confusion arising from verbal looseness there is another less innocent factor. It seems to me that there is often just plain resentment that changes in accustomed routine are so often the outcome of investigations in pure science. Large numbers of the genus homo do not like to be shaken out of an accustomed routine. It is this resentment more than anything else which I believe leads to fastening of "responsibility" on pure scientists. In extreme cases this has even led to the demand for a compulsory moratorium on all scientific investigation.

I think there has been a tendency for scientists in general and physicists in particular to acquiesce too meekly in the implication of social responsibility for their discoveries. The conjuring up of "responsibility" is often only the device of a lazy man to get some one else to do for him something of vital concern to him which he should be doing himself, and scientists in their naiveté have not seen this.

Let us imagine what acceptance of the thesis of responsibility would involve. Perhaps the most fundamental of all the conditions for success in scientific discovery is complete freedom. If the scientist were required to make only those discoveries which could not wilfully be perverted to harmful uses, he would almost certainly feel himself so restricted that he would make no discoveries at all. Furthermore, it is impossible for a physicist or any one else limited by human fallibility to foresee all the consequences of a discovery, much less, to balance all the good consequences against all the bad consequences. Responsibility does not exist when there is no mechanism by which the responsibility can be determined. Neither is there any mechanism by which the physicist can control such consequences of his discoveries as he can foresee. It is society as a whole that is in a position to provide the mechanism of control rather than the individual discoverer, so that it is therefore the responsibility of society to see that discoveries in pure science are properly exploited, not the responsibility of the discoverer. When a physicist makes a new discovery and imparts it to society, he is presenting society with an opportunity, and this opportunity implies responsibility on the part of society.

Society already has available a mechanism of at least partial control in a control of patents and production. Whether an entirely adequate control could be exercised in a framework of a society broken up into separate nationalities as at present may not be easy to decide; certainly the decision and the resultant action is out of the province of the individual scientist.

What is it that makes the "pure" physicist go when he is on the trail of some new idea in his laboratory? The answer is, of course, complex, but I believe that through all the multifariousness runs one simple guiding thread, the craving for understanding. To the extent that the guiding motif of an enterprise is the craving for understanding, to that extent the enterprise may be said to be purely scientific, as distinguished from technological, or utilitarian, or artistic, or political, or what not. The craving for understanding reaches its greatest poignancy only in a few cases, but all of us who are engaged in pure research have it to a certain extent, and it is the vital part of what makes us go. It is not a matter to be argued about, as to whether such a craving has economic or other justification; it is only to be accepted as a fundamental fact about human beings that some of them have developed to a high degree the passion for understanding and a delight in the corresponding activities, just as others have a strongly developed sense of beauty or of conduct. If society is ever going to become anything more than a vicious merry-go-round of circular activity, if ever there are ends in themselves or goods in themselves, then surely the gratification of the craving for understanding is one of them.

To those who have a passion for understanding

society will not be a satisfactory place unless it affords opportunity for the acquiring of understanding, so that to the extent to which the function of society is to make life satisfactory for its members, and it seems to me that this is pretty nearly the whole function of society, one of its responsibilities is the making and providing of adequate scientific opportunity. Society is the servant of science even more and in a more fundamental sense than is science the servant of society. Any control which society exerts over science and invention must be subject to this condition.

Physicists are, I think, even if they give intellectual assent, inclined to be too diffident to insist on all the implications of this conclusion. Many of us find it uncongenial to thrust ourselves forward and to insist on the service owed us by society, particularly at the present. We have a feeling that we should not confuse the issue of winning the war by insisting on matters of obvious personal concern at a time when the very existence of the society to which we are accustomed is threatened. I would urge that on the contrary now is the time more than ever to insist that society must conform to the pattern of service to science. What are we fighting for anyway? After we have scavenged the world of the blight of totalitarianism, what are our long-range objectives? Have we nothing eventually in view more admirable than the abolition of want and the securing of comfort for everyone, ends which at present bulk so large in our programs? Will we be permanently satisfied with these, or will something more be necessary to give dignity and worth to human activity?

In urging the claims of science and scientists on society we may fortify ourselves by reflecting that we are not urging society to give without return. The exercise of the mind and the acquiring of understanding is after all not an ignoble human activity. In more idealistic phraseology it is sometimes described as the pursuit of truth. One might even argue that it is the one human activity which distinguishes us most from the brutes; certainly it is the one in which there is the greatest room for future development and in which we have most failed up to now to realize our full potentialities. In the long run society is a better place for every one when there is intellectual freedom and encouragement and flourishing activity in pure science. It does not put much of a strain on other social mechanisms to have scientific activity going on, nor are we an obtrusive class. We work hard and like it; the pursuit of personal comfort or even happiness is not a particularly compelling motive with us; there is a certain disinterested impersonality in our striving which has on occasion been commended. We do not ask for much in comparison with what we give: freedom and leisure to do our work and decent security for the future. Many of us already have been more or less fortunate in these respects, and some of us already have been living under conditions which approach the millennium according to our simple standards. But it seems to me that the prospect is becoming less bright. Not many people like to use their minds, and there is always some spontaneous hostility of those who do not like to think toward those who do. For years before the war there were signs of a growing anti-intellectual sentiment, which I believe is now becoming visibly intensified with the passions and emotions always associated with war. It seems to me that scientists are curiously obtuse as to the social conditions which make possible their existence as a class. It is by no means a certainty that society will so evolve that the individual will be allowed to engage in independent intellectual activity. The danger of such an evolution increases with the growing command by society of techniques assuring a satisfactory degree of common ease and comfort. Society may well come to feel that the scientist has not enough more to give it in the way of material benefits to justify keeping him. If society is ever going to become a place in which intellectual activity is encouraged and intellectual ability prized, those of us who like to think have got to fight for it. If we do not take action in our own behalf, no one else will do it for us. And we must do it now because social institutions are changing so rapidly that after the war it may be too late. Judging by the one criterion of greatest significance in this country, economic position, there is no doubt that the changes now taking place are leading to a worsening of the position of those who like to think as contrasted with those who do not. When we contemplate all the pressure groups insistent only on their own advantage, we need not be diffident in striving for an even greater recognition than in the past of the social importance of intellectual activity, and of the importance of stimulating such ability by commensurate rewards.

A distorted conception of democracy is forming under stress of the war, a conception which urges the equal right of every one to share the goods of society irrespective of what he gives back to society. The conception of democracy which was implicit in the old fashion "American ideal" seems to me more admirable. According to this conception democracy meant equal opportunity for ability, no matter how humble its origin, to rise to its natural level. So far as capitalism was discussed at all, it was justified, at least in theory and in spite of its defects, because it incidentally provided a machinery by which special service received special reward. It was not considered that a society was either ignoble or undemocratic that gave special reward for special service. Nor was the individual who consented to receive special reward for special service considered to have debased himself. It was felt

that society need not grudge to act to its own advantage because it was also for the advantage of the individual; society did not resent the individual of exceptional abilities but took pride in him. It seems to me that a certain crabbed and ungenerous spirit of envy and resentment against unusual ability is growing; this is underlined by recent events. To me there is something dead wrong with a social philosophy that attempts to set *any* upper limit to the value of the contribution which a man of unusual ability can make to his society, particularly in time of war. In the name of democracy our ideals are becoming less democratic. A partial explanation is doubtless to be found in industrial and capitalistic abuses. But an explanation does not constitute a justification.

We, who are perhaps more vitally concerned than any other group, have thus far failed to take steps to ensure that the economically altered society of the future shall retain those essential features that once inspired our democratic vision. Our conviction has not been strong enough that a society is a good society in which intellectual ability is prized and rewarded. We are passively accepting a change in the economic system by which the relative position of all intellectual workers, including the scientist, is being definitely debased, and in which assurances and commitments made by society in the past are being needlessly scrapped. This applies with particular force to the private universities and to the workers in them. We are not fighting against these things ourselves, and we in the universities are not insisting that our university and educational administrators fight for them for us.

What are we going to do about it? In the first place, we are not going on strike, but those of us who are in the position will continue to work as hard as we can to develop all the devices in the power of our ingenuity or to make what other special contributions we can to destroy totalitarianism and all that it implies. Neither, I think, will scientists attempt to organize themselves into a pressure group to try to mold society to their pattern. Even if it were not ludicrous for so small a minority to think of making such an attempt, we would find such an attempt distasteful at a time when so many of our young men are being called on to make extreme sacrifices. And even if not distasteful, who could find time to devote to such an attempt when we are all so busy with immediate things? But it would be stupid not to take time to at least see what the situation is, and once having seen it, it will be possible to do many things incidentally without slackening in our other efforts. Merely by letting it be known that we are aware of the situation we may accomplish something. From the long range point of view our job is primarily one of education. We should avail ourselves of every opportunity and even go out of our way to make opportunity to let our conviction be known that a society is in the long run the best society in which those who have the ability are given every opportunity and inducement to practice the pursuit of truth and of understanding. We must hold up intellectual power and accomplishment to the admiration and emulation of our young and stimulate their pleasure in intellectual activity. Our educational programs must be revised if necessary to give this emphasis. We must teach our young a social philosophy which recognizes that society is a means and not an end, and we must give them a technique by which they can discover those ends which they can accept with intellectual integrity as making society worth while. If we do not do these things, we are in danger of finding when this struggle is over that we have been fighting for a lifeless husk; if we do them we will be playing our part in molding a public opinion which will create the society of our vision.

DIGITALIS AND SOME OF ITS DERIVATIVES. II

By Dr. HARRY GOLD

DEPARTMENT OF PHARMACOLOGY, CORNELL UNIVERSITY MEDICAL COLLEGE

(*Continued from page 129*)

One of the results of these studies was to show that a similar number of units determined on the frog (U.S.P. XI units) produced widely different effects, while the degree of effect paralleled the number of units determined on the cat. The frog, therefore, appears not to be a suitable animal for the standardization of digitalis preparations that are to be used in man. When the frog and the cat method give different answers in a comparison of specimens of digitalis, that obtained with the cat method is more nearly applicable to humans.

The cat method has now been adopted as the official method of assay in the Twelfth Revision of the U. S. Pharmacopeia. It is to be expected that in the future the potency of digitalis preparations of commerce will be more uniform.

There are certain objections to the cat method as well, since the technique involves intravenous injection, and in that way it fails to distinguish between absorbable and non-absorbable material. This is a matter of some importance, since digitalis is most commonly administered orally in man.

There is abundant reason for the belief that the potency of a specimen of digitalis or a glycoside which is to be used in man should be assayed directly on man.

A method for the assay of digitalis directly on humans has been developed.[21]

Fig. 4 illustrates the technique of an assay in one human subject. The average of a series of such cases represents a complete assay. The essential principles

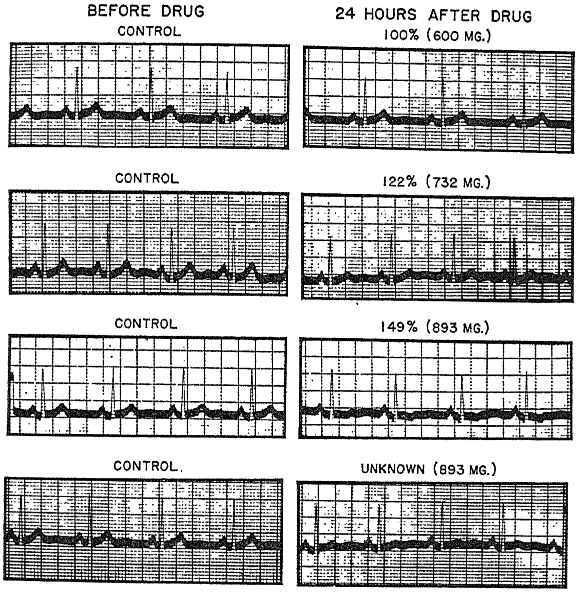

FIG. 4. Assay of digitalis directly on man. Subjects are selected in whom the T-wave is a sensitive indicator of digitalis action. The response of the T-wave is calibrated by graded doses of the standard (U.S.P. Reference Standard) given at one-month intervals. In the above case, T-wave changes clearly differentiate 22 per cent. differences in doses of the standard. Note that 893 mg of the unknown produce an effect between that of 732 and 893 mg of the standard. Hence the unknown has a potency approximating 812 mg or 91 per cent. of the standard.

of bioassay are applied in this method. The sensitivity of the test subject is first determined. A dosage-response curve is established for each case, and the unknown specimen is compared with a standard within the range of the points on this curve.

The reproducibility of results with the human assay, if it is carried out on a properly selected group of human subjects and the technique is followed in all its details, is quite remarkable. We have had an opportunity to assay one specimen of digitalis four times, once in the form of tablets, another time in the form of capsules of the leaf, then in the form of a tincture made from the leaf, and another time in the form of a second tincture made from that leaf. These assays were made on different groups of patients. In humans, the first proved to be 82 per cent. of the potency of the Reference Standard, the second 77.8 per cent., the third 86.9 per cent. and the fourth 77.5 per cent. The average for the four assays of the same specimen indicated that that digitalis was 81 per cent. of the standard, with a maximum deviation from the lowest to the highest figure of less than 10 per cent. Such reliability is not often obtained by animal assay methods.

It is, of course, the hope that one day digitalis materials in general use will be sufficiently pure and constant so that their identity will be ascertained by more precise physical and chemical methods. In that case, we shall dispense with bioassay. But until then the human assay provides the final decision in the matter of the potency of digitalis. To be sure, the human method of assay is not as convenient as the animal methods. The subjects are not as accessible to as many workers. When the importance of human assay is better recognized, however, the apparent disadvantage may be turned to good use in that fewer batches of digitalis may be subjected to assay. The pooling of digitalis into larger units for assay would in itself go a long way toward establishing uniform potency among this group of drugs.

Closely related to the matter of bioassay of digitalis is the problem of digitalis deterioration. After a tincture is stored for about 3 or 4 months it may lose as much as 50 per cent. of its previous potency as revealed by the frog test. But, by the cat test, the tincture usually retains its previous strength. The explanation of this is not clear. It may be that, upon standing, the potent glycosides in the tincture undergo some form of physical change which alters their absorption from the lymph sac of the frog, although in this form it retains its full potency when injected intravenously in cats. Tests with a very old tincture which had "deteriorated" to about one half its strength by the frog method showed full strength in humans. These tests were made by the method illustrated in Fig. 3.

There is considerable controversy concerning the question whether or not the quality of action of different digitalis glycosides is the same. If one material fails to produce satisfactory therapeutic effects, assuming that it has been absorbed and that the dose has been large enough, is it likely that some other preparation of digitalis will accomplish more? That question arises particularly in connection with the treatment of patients in advanced heart failure whose response to digitalis materials is often incomplete or equivocal. From the results of some of the more recent experiments with heart-lung preparations,[22] the conclusion has been drawn that the margin between therapeutic and toxic effects on the heart is much wider for some than for other glycosides. The existing

[21] H. Gold, McK. Cattell, H. L. Otto, N. T. Kwit and M. Kramer, *Jour. Pharmacol. and Exp. Therap.*, 75: 196, 1942.

[22] G. K. Moe and M. B. Visscher, *Jour. Pharmacol. and Exp. Therap.*, 64: 65, 1938.

evidence for this view leaves much to be desired. No significant differences in the margin between toxic and therapeutic doses of a wide variety of digitalis glycosides could be observed in the experiments on the mammalian papillary muscle.[23] The subject has also been studied in man. In these experiments the ratio of therapeutic to toxic dose was measured by the incidence of toxic symptoms when the therapeutic dose was doubled. It was found that with this as a criterion, the spread between the therapeutic and toxic dose for the preparations studied, digitalis, Lanatoside-C and Digitoxin, were substantially the same. The view that strophanthin by intravenous injection produces effects which can not be obtained with digitalis has been popular in the European literature for many years, and has recently been revived in this country. No good evidence exists that this is so, provided suitable measures have been taken to insure that adequate amounts of the glycosides have reached the circulation. We have compared several digitalis materials by intravenous injection, giving the same number of cat units of each in a single dose: ouabain, Lanatoside-C or Cedilanid, Digitoxin and the mixture of glycosides found in digitalis in the form of Digifoline (Ciba). A single injection of 3 cat units of each produces approximately the same result. The effects appear within a matter of minutes, are fully developed within about 1 to 2 hours, and the degree of the effect when fully developed is substantially the same. These experiments were made in patients with auricular fibrillation confined to bed in the hospital, after a long control period, in much the same way as those described in Fig. 3.

One of the most significant pharmacological properties with respect to which digitalis materials show wide differences is that of absorption from the gastrointestinal tract. We have studied this factor in man by the comparison of the amounts necessary to produce the same effect by oral and intravenous administration. all comparisons being made in one and the same subject. The results show that, while digitalis and its tincture are the most absorbable among the crude members of the digitalis group, not more than about one fifth of the potent materials in digitalis plays a part in the therapeutic effects of the drug when administered orally. The rest is chiefly non-absorbable material. An intravenous dose of 3 to 5 cat units produces the same effect as 15 to 20 cat units given orally in the same patient.

The purification of digitalis has often resulted in little improvement in absorption (Fig. 5).[24] The purified principles are in some instances more poorly absorbed than digitalis leaf, as shown by the wide spread between the intravenous and the oral dose necessary for an equal effect. The most outstanding exception is Digitoxin (Digitaline Nativelle). We

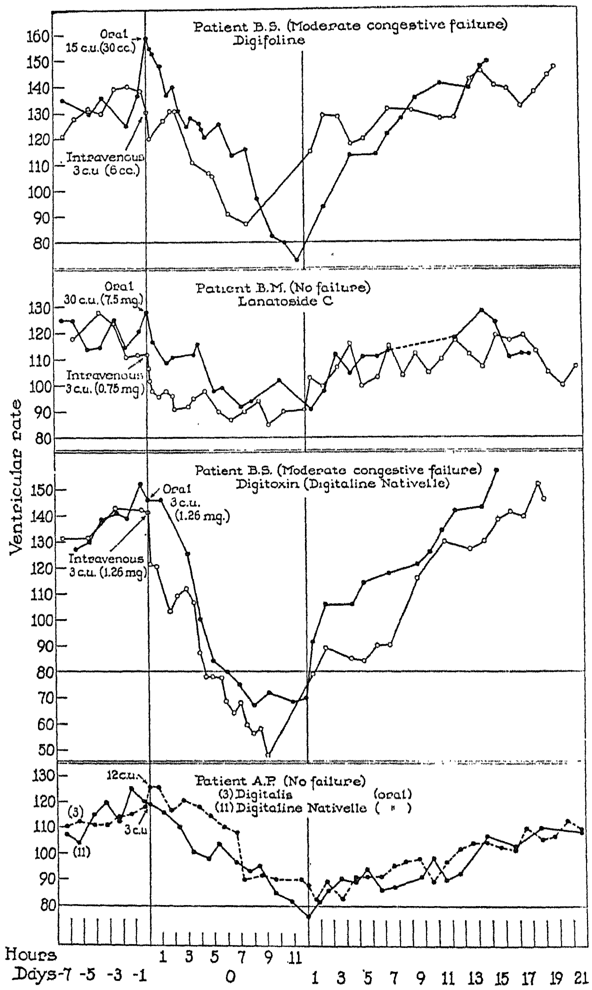

FIG. 5. These patients had auricular fibrillation and were confined to bed. The points on the curves were obtained in the same way as those in Fig. 3. Note that the ratio of oral to intravenous dosage for Digifoline is 5: 1, for Lanatoside-C 10: 1, for Digitoxin 1: 1. Although these ratios vary somewhat from one experiment to another, they represent the usual relationships for these preparations.

have recently subjected this material to more intensive study in animals and man. It possesses a property quite unique for a digitalis body, that of complete absorption from the gastrointestinal tract. A given amount produces the same intensity of effect whether given orally or intravenously. The full digitalizing doses by the two routes in man are practically identical, namely, 1.25 mg or a total of 3 cat units. It is absorbed directly through the wall of the stomach.

These properties have been put to use in an im-

[23] McK. Cattell and H. Gold, *Jour. Pharmacol. and Exp. Therap.*, 71: 114, 1941.

[24] Differences in elimination and destruction within the intestinal tract may play a minor part in the differences attributed to absorption.

proved technique for the treatment of heart failure. In the case of digitalis, it is customary to take a day or two or longer to induce the full effects. The full dose, whatever it is estimated to be, 1 gram or 1.5 grams for a given individual, is divided into 4 or 5 fractions and given at 6- or 8-hour intervals. It is not essential to give it all at one time, since the average patient with heart failure is not *in extremis,* and little is lost by taking 2 or 3 days rather than 6 to 8 hours to induce the full effects. However, the chief reason for the divided doses is the fact that from a single full dose given at one time poisoning may result in the more susceptible individuals. Since varying susceptibility as measured by oral doses includes the factor of varying absorption, it was considered that Digitoxin (Digitaline Nativelle), which is rapidly and, for practical purposes, completely absorbed from the gastrointestinal tract, might provide a means of safe full digitalization by a single dose method. This was found to be the case. The average full digitalizing dose of 3 cat units (1.25 mg) may be given at one time to the patient with heart failure who has not recently received digitalis. It induces the full effects within a period of about 6 hours, sometimes more quickly. With this material there is provided a safe routine procedure of oral digitalization within a few hours rather than in days, as is the case with the customary technique by which digitalis is used.

Digitalis leaf or the tincture can not take the place of Digitoxin in the single dose method of digitalization. A therapeutically equivalent dose represents about 15 cat units, and this causes nausea and/or vomiting in 1 out of every 5 patients within less than two hours, due to a local irritant action, although the local emetic action of digitalis is rarely seen when the full amount is given in a series of small fractions. On the other hand, in the case of Digitoxin, a local emetic action is rarely seen even after the single full digitalizing dose, because the total glycoside for the full effects amounts to only 1.25 mg.

A sharp distinction needs to be drawn between the local and the systemic emetic action of the digitalis bodies. All the digitalis glycosides exert both types of action. We have experiments, however, with various materials such as the glycosides of squill, extracts of digitalis purpurea and of digitalis lanata, and ouabain, which indicate that it requires between 5 and 10 mg of the glycosides, sometimes more, to produce nausea and vomiting by the local action in the gastrointestinal tract. Such an action is therefore to be expected in the case of digitalis materials in which so much of the glycoside is necessary for the full therapeutic effects. It is not likely to occur with those materials of which, by reason of their high potency and completeness of absorption, smaller total amounts of glycosides suffice for full therapeutic effects.

OBITUARY

FRANZ CARL SCHMELKES
1899–1942

HIS colleagues in chemistry, his many friends in the field of medicine and his associates in the industry were shocked to learn of the death of Franz C. Schmelkes. After reiewing his last manuscript he left his office on the evening of December 11, and did not return to his desk the next morning as expected. He had succumbed to a heart attack during the night. This marked the end of a life unusually productive in the realm of science and its industrial applications.

He was born in Prague in 1899, and received his training in organic chemistry at the Carl-Ferdinand University in the same city. He obtained the degree of doctor of philosophy in 1922. For four years he worked in Hanover, Germany, at the Continental Rubber Company and in 1925 he came to the United States. Before joining the staff of the Research Laboratories of Wallace and Tiernan Company, he was associated with the Dovan Chemical Company in Newark, and the Davis Emergency Equipment Company in Hoboken, N. J. For about a decade he had been the assistant director of research of Wallace and Tiernan Products, Inc.

His first major contribution was the synthesis of N,N′-dichloroazodicarbonamidine, a chloramine which is now widely used as a disinfectant. He often referred to this chlorine compound as a "chlorine reservoir" and he felt that its success as a disinfectant is not only due to the slow release of chlorine but also to a quasi-selective action towards bacteria. He and his associates investigated its disinfecting properties extensively, and he collaborated closely with those physicians who used it clinically. His work with this disinfectant brought him in close contact with medicine; and in a short time he acquired an amazing knowledge in all branches of this science. He applied his knowledge of organic chemistry with great ingenuity to problems of therapeutics and usually attacked these problems on a broad front and on the basis of a rather general working hypothesis.

Stimulated by some evidence in the literature indicating that isosteric compounds are similar in their biological activity, he synthesized a group of isosteric compounds and investigated them pharmacologically. One of these was a thiamine analogue; another, a nicotinic acid analogue. Both compounds showed a considerable and specific vitamin activity.

In recent years he was intensely interested in the mechanism of sulfonamide action. He investigated the effect of the hydrogen ion concentration on the activity of sulfonamides *in vitro* and found an interesting correlation between the acidic dissociation constants of the sulfonamides and the effect of the pH upon their activity. The conclusion could be drawn from the data collected by him and his associates that the anionic form of sulfonamide is a great deal more active than the undissociated sulfonamide molecule and that the activity of the latter is negligible in comparison. The activity of sulfanilamide, in particular, was found to be greatly enhanced by the adjustment of the pH. The activity of sulfanilamide at the optimal pH, although not directly measured, was calculated to be greater than that of any other known sulfonamide. The practical conclusion was drawn that the local chemotherapy for wound infections should be carried out with sulfanilamide and a buffer.

He was a strong advocate of the theory that sulfonamide activity is due to the blocking of the *p*-aminobenzoic acid receptor in an enzyme system, and on the basis of this theory he and his associates synthesized various *p*-aminobenzoic-acid derivatives, some of which showed a typical sulfonamide activity, that is, anti-bacterial activity which could be reversed by *p*-aminobenzoic acid. He realized the practical importance of inactivating the *p*-aminobenzoic acid which is the antagonist of sulfonamide in local chemotherapy and he worked intensely on the study of the use of N,N′-dichloroazodicarbonamidine for this purpose.

Since Pearl Harbor, he has concentrated all his efforts on the medical aspects of the war. He developed an ingenious treatment of burns, using a membrane which contains buffered sulfanilamide as a chemotherapeutic agent.

Franz Schmelkes' interest was not limited to science but embraced political, social and economic problems. He had beliefs and convictions for which he was always ready to fight. His greater interest was in his fellowmen, many of whom he helped when in need. He was a member of many scientific societies and was popular at the Chemists' Club. One of his favorite sports was golf. His guiding spirit and stimulating influence will long survive among his friends and associates who will miss him greatly.

L. REINER

RECENT DEATHS

DR. EDGAR ALLEN, professor of anatomy and head of the department at the Yale University School of Medicine, died on February 3 at the age of fifty years.

DR. EARLE RAYMOND HEDRICK, a member of the faculty of the Brown University Graduate School in Advanced Instruction and Research in Mechanics, formerly vice-president of the University of California at Los Angeles, died on February 3 at the age of sixty-six years.

DR. LEONARD MAGRUDER PASSANO, professor emeritus of mathematics of the Massachusetts Institute of Technology, died on January 30 in his seventy-seventh year.

DR. J. FRANK FRASER, consulting dermatologist at the Memorial Hospital for the Treatment of Cancer and Allied Diseases and other New York hospitals, has died at the age of seventy-two years.

MISS CAROLINE HARRISON, better known to her friends as "Carrie Harrison," died at her home in Washington, D. C., on about January 19. She entered the government service in the division of botany of the Department of Agriculture in 1887. The division later became a part of the Bureau of Plant Industry. Miss Harrison gave special attention to tannin-bearing plants. She was an enthusiastic rosarian, and was an active member of the American Rose Society up to the time of her death. She retired from government service in April, 1926.—F.A.W.

SCIENTIFIC EVENTS

THE BRITISH NEW YEAR HONORS LIST[1]

THE following names of scientific men and others associated with scientific work appear in the British New Year honors list:

Baron: Sir Charles Wilson, president of the Royal College of Physicians.

Baronet: W. M. Goodenough, chairman of the Nuffield Trust for the University Medical School, Oxford.

G.B.E.: Sir Henry Dale, lately director of the National Institute for Medical Research, president of the Royal Society.

K.C.B.: Sir Wilson Jameson, chief medical officer, Ministry of Health and Board of Education.

Knights: Professor J. H. Clapham, president of the British Academy; Professor F. Clarke, professor of education, University of London; Dr. A. C. G. Egerton, professor of chemical technology, Imperial College of Science and Technology, and joint secretary of the Royal Society; Jhanendra Chandra Ghosh, director of the Indian Institute of Science, Bangalore; S. H. Howard, inspector-general of forests and president of the Forest Research Institute, Dehra Dun; Pestonji Rustom Masani, lately vice-chancellor of the University of Bombay; W. A. Stanier, chief mechan-

[1] From *Nature*.

ical engineer L.M.S. Railway and scientific adviser to the Minister of Production; Brigadier E. O. Wheeler, surveyor-general of India; J. Wright, chief engineer, Central Electricity Board.

C.M.G.: D. Yates, a leading metallurgist of South Australia.

C.I.E.: Bhagavathulu Viswanath, officiating director, Imperial Agricultural Research Institute, New Delhi; R. A. MacGregor, chief metallurgist, Department of Supply, Calcutta.

C.B.E.: Dr. W. R. Aykroyd, director of nutritional research, Coonoor; E. Barnard, director of food investigation, Department of Scientific and Industrial Research; R. Gushue, chairman of the Fisheries Board, Newfoundland; E. H. E. Havelock, administrative secretary of the Agricultural Research Council and Secretary of the Development Commission.

THE TINGO MARIA EXPERIMENT STATION

A special correspondent in Lima, Peru, of *The New York Times* reports that Dr. Benjamin J. Birdsall, of the Office of Foreign Agricultural Relations of the U. S. Department of Agriculture, has been appointed director of the agricultural experiment station at Tingo Maria. He arrived in Peru at the end of July. The United States, through the Department of Agriculture, in cooperation with the State Department is contributing financial and technical aid, while Peru is contributing land, buildings and other facilities.

The station at Tingo Maria is one of a series of agricultural experiment stations being established throughout the American tropics designed to assist and encourage the production on a large scale of rubber, quinine and other products formerly obtained from the Far East. As assistants, Dr. Birdsall has William Wickline, formerly in the U. S. Government service in entomology and plant quarantine work, and Rolland Lorenz, a rubber expert, formerly with the Firestone Company in Africa. In 1940 Dr. Lorenz was a member of one of the U. S. missions which made a survey of the rubber possibilities of tropical America. The American group at Tingo Maria works in direct cooperation with Pedro Recavarren, director of forest lands and colonization. Pedro Beltran is serving as government aide in the organization of the undertaking.

The experiment station at Tingo Maria, which is situated on the Huallaga River on the eastern slopes of the Andes, according to *The New York Times* correspondent, will consist of three main buildings and twenty residences all constructed of brick with enternite roofing. The principal building or "head house plant," as it is called, will comprise the main laboratories and greenhouses. In addition there will be an administration building with offices and library, and a dormitory or club-house for single men. The cost will be in excess of $160,000, and the building program is expected to take two years. A plant for fabricating the brick is now being completed at Tingo Maria. The grounds of the station cover five hectares, along the Central Highway of Peru, within the urban limits of the town of Tingo Maria. Additional land is being acquired for the experimental work.

GIFTS RECEIVED BY THE UNIVERSITY OF WISCONSIN

At a recent meeting of the Board of Regents of the University of Wisconsin, it was announced that gifts had been received amounting to $38,811.

The sum of $5,500 was given by Lever Brothers Company, Mass., for the continuation of an industrial fellowship in biochemistry, under the supervision of Professor Harry Steenbock. A grant was made also by the Wisconsin Alumni Research Foundation for the support of the general research program of Professor Steenbock.

Federal aid amounting to $4,720 was accepted for the Public Health Nursing program of study for the training of twenty-two public health nursing students.

In addition to a number of smaller gifts, $1,000 was received from the State Rural High Schools Committee for a field study in rural community education by Clarence E. Ragsdale, associate professor of education; $1,000 from the National Canners Association, Washington, D. C., an addition to the original grant of $3,000 for an industrial fellowship in biochemistry; $1,500 from General Mills, Inc., Minneapolis, for the continuation of an industrial fellowship in the department of biochemistry, under the supervision of Professor C. A. Elvehjem; $1,200 from Eli Lilly and Company, Indianapolis, for the renewal of an industrial fellowship in the department of biochemistry, also under the supervision of Professor Elvehjem, and $3,000 from the National Canners Association for the establishment of an industrial fellowship in the department of biochemistry under the supervision of Professor Elvehjem and Professor F. M. Strong; $1,000 from the Oscar Mayer Company, Madison, for the establishment of an industrial fellowship in the department of animal husbandry under the supervision of Professor A. E. Darlow; for the support of scholarships of $75 each for farm boys, $750 was given by Oneida Farms, Inc., and $300 by the Oscar Mayer Company.

Five hundred dollars was received from the Wisconsin Alumni Research Foundation, as an addition to the $5,000 grant for an industrial fellowship in biochemistry, under the direction of Professor Karl Paul Link; and $2,000 from the Upjohn Company, Kalamazoo, for the establishment of a research assistantship in the department of pharmacology and toxicology, under the supervision of Professor A. L. Tatum.

WAR SERVICES OF THE UNIVERSITY OF ILLINOIS

THE extent to which the Federal Government has called upon the University of Illinois for special war services is reported by Comptroller Lloyd Morey, who states that special war contracts with the university involve the sum of $2,383,694.

They are being carried on in addition to the regular work of instructing 11,495 students, of whom 4,700 are in the Reserve Officers Training Corps and 2,915 in the enlisted reserves; to the regular research activity, much of which has war value; and to the release of 485 staff members on leave for military and war work.

The largest special activity in terms of persons involved is the engineering, science and management war-training program being carried on in fifty-two Illinois industrial areas by the Division of University Extension for the U. S. Office of Education; 15,928 war workers have been trained or are now in classes. For this training program the university has received $955,798.

The U. S. Navy has established at the university a training station for 2,000 signalmen, diesel officers, diesel engineers, and cooks and bakers. For housing, laboratories, classrooms, meals and other services, and for necessary changes in the buildings to meet Navy needs, the Federal Government has contracted to pay $963,725, and has paid $665,000 up to January 21.

The university has twenty-nine research contracts with various Federal agencies involving the sum of $439,354 for work in the physical sciences, chemistry, medicine and engineering. Several other research projects are being planned and may soon be under way. From the Civil Aeronautics Authority $24,817 has been paid for the training of 270 student pilots.

RARE CHEMICALS

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.:

1. Na Hyposulfate
2. Adonitol
3. Phosphoglyceric aldehyde
4. Hydroxypyruvic acid
5. Quinic acid
6. Thionalide (Thioglycolic Acid-B-Amino Naphthalide)
7. Dimethyl Acetylene
8. Protocatechuic Acid
9. Tribromo Caffein
10. Trimethyl Borine Amine
11. Indican
12. 2-Desoxyribose
13. a-Tetralone
14. Cyclopentadiene Carboxylic Acid
15. Triphosgene
16. Methyl vinyl ketone
17. Boron trichloride
18. Ethylene diamino tetra acetic acid
19. Nitrile triacetic acid
20. Organic compounds of selenium

THE RESEARCH AWARD OF ELI LILLY AND COMPANY

THE annual meeting for 1942 of the Society of American Bacteriologists originally scheduled for December 28, 29 and 30 at Columbus, Ohio, was cancelled at the request of the Office of Defense Transportation. This necessitated the postponing of the research award given by Eli Lilly and Company. It was presented at a joint meeting of the Iowa State College Branch of the Society of Sigma Xi and the North Central Branch of the Society of American Bacteriologists, on January 28, to Dr. Harland G. Wood.

The annual research award of $1,000 and a bronze medal have been offered by Eli Lilly and Company to a young man or woman, under thirty-five years of age, who has made outstanding contributions to knowledge in the fields of bacteriology or immunology while conducting investigative work in a non-commercial research or educational institution in the United States or Canada. This award is being made to stimulate research activity in young people and to recognize meritorious achievement and promise at an early stage in their careers. The recipient is chosen by an award committee composed of members of the Society of American Bacteriologists, the American Association of Immunologists and the American Society for Experimental Pathology. This year an unusually large number of nominees with impressive records of accomplishment was submitted to the committee. From them, the committee has selected as the 1942 recipient of the award Dr. Harland G. Wood. The citation reads:

> The award is made on the basis of Dr. Wood's outstanding contributions to bacterial physiology. In this work it was shown that typical heterotrophic bacteria utilize carbon dioxide in their metabolism and that the carbon dioxide is bound to other carbon compounds playing an important part in cell physiology. The bound carbon dioxide was traced to show its location in the resulting compounds and its important role in respiration. The scope and significance of these findings was broadened materially by the further demonstration that this change is not limited to microorganisms but applies to higher forms of life.
>
> This work is significant as a contribution to fundamental life processes. It shows that the distinction between autotrophic and heterotrophic microorganisms can not be drawn as sharply as formerly believed. It indicates a starting point for further study of autotrophic carbon dioxide utilization and photosynthesis. It is an important contribution to the study of cell respiration.

It possesses broad significance as another link in the chain of accumulating evidence indicating general similarity of many metabolic processes in diverse forms of life.

Dr. Wood's first contribution to this field was made in 1935, and he is one of the pioneers in opening a new avenue of study in bacterial physiology. Throughout these investigations Dr. Wood has shown himself to be a skilful and versatile investigator bringing to the solution of his problem methods and technics from several fields of scientific endeavor.

COMMITTEE ON APPLIED MATHEMATICAL STATISTICS OF THE NATIONAL RESEARCH COUNCIL

THE Committee on Applied Mathematical Statistics of the National Research Council and its subcommittees will be concerned with problems involving personnel and organization, research and production. The services which it is prepared to render are consultation, assistance in the organization and direction of special research projects and the preparation of necessary manuals on statistical techniques.

At present, the committee is particularly interested in the use that industries and government agencies may make of statistical quality control in production. Those industries and government agencies that have been making use of statistical quality control find that it has been possible to reduce the quantity of defective material, the amount of necessary inspection, reduce the tolerance range where necessary in order to save material, and attain assurance that the quality of material that can not be inspected one hundred per cent. because of the destructive nature of the test will meet the standard specified. The general oversight of this phase of the work of the committee is in charge of Dr. Walter Shewhart.

The membership of the committee and subcommittees is as follows:

Committee on Applied Mathematical Statistics:

Luther P. Eisenhart, *Chairman.* (Chairman of the Division of Physical Sciences.)

Edward U. Condon, Westinghouse Electric and Manufacturing Company.

Lowell J. Reed, School of Hygiene and Public Health, the Johns Hopkins University.

C. F. Roos, Institute of Applied Econometrics, Inc., 500 Fifth Avenue, New York City.

W. A. Shewhart, Bell Telephone Laboratories, Incorporated.

Hugh M. Smallwood, United States Rubber Company, Eau Claire, Wisconsin.

John M. Stalnaker, Princeton University.

S. S. Wilks, Princeton University.

Sewall Wright, Department of Genetics, the University of Chicago.

Liaison members:

Victor Perlo, Office of Price Administration.

Commander Lybrand Smith (retired), Navy Department.

Herbert Stein, War Production Board.

Lieutenant Colonel John D. Witten, War Department.

Subcommittee on Mathematical Statistics:

S. S. Wilks, *Chairman.*

Churchill Eisenhart, University of Wisconsin.

W. Edwards Deming, Bureau of the Census.

Subcommittee on Biology:

Sewall Wright, *Chairman.*

Chester I. Bliss, Yale University.

John W. Gowen, Iowa State College.

George W. Snedecor, Iowa State College.

Subcommittee on Chemistry:

Hugh M. Smallwood, *Chairman.*

Warren F. Busse, B. F. Goodrich Company, Akron, Ohio.

Henry Eyring, Princeton University.

Oscar K. Rice, University of North Carolina.

Felix L. Yerzley, Pioneer Instrument Division, Bendix Aviation Corporation, Bendix, N. J.

Subcommittee on Medicine:

Lowell J. Reed, *Chairman.*

John W. Fertig, College of Physicians and Surgeons, Columbia University.

Hugo Muench, Rockefeller Foundation.

Margaret Merrell, School of Hygiene and Public Health, the Johns Hopkins University.

Alan E. Treloar, School of Medicine, University of Minnesota.

SCIENTIFIC NOTES AND NEWS

DR. RAY LYMAN WILBUR, chancellor of Stanford University, received on February 1 at the annual national dinner meeting of the American Social Hygiene Association, of which he is president, the William Freeman Snow Medal "for distinguished service to humanity." The medal was awarded "in recognition of the outstanding work he has done to protect American youth from the ravages of social disease."

DR. M. E. WEEKS and Jack Todd, of the Kentucky Agricultural Experiment Station, will receive the King Award for the most meritorious paper presented for 1942 by the Kentucky Academy of Science for their paper, "The Determination of Magnesium as the Quinolate Using the Colorimetric Ferric Chloride Method."

STANLEY FIELD has been reelected president of Field Museum of Natural History and has begun his thirty-fifth consecutive year of service in that office.

PROFESSOR W. D. CAIRNS, of Oberlin College, has been elected president of the Mathematical Association of America. Professor C. C. MacDuffee, of

Hunter College, has been elected *second vice-president;* Professors Saunders Mac Lane, of Harvard University, and E. J. Moulton, of Northwestern University, *governors at large,* and Professor B. W. Jones, of Cornell University, *associate secretary.* On January 1, Professor W. B. Carver, of Cornell University, became secretary-treasurer. The office of the association is now in McGraw Hall, Cornell University, Ithaca, N. Y.

THE New York City branch of the Society of American Bacteriologists has elected the following officers for the year 1943: *President,* Mary B. Horton; *Vice-president,* Gustav Steffen, and *Secretary-Treasurer,* Mortimer L. Starr, department of biology, Brooklyn College.

DR. MAYO H. SOLEY, associate professor of medicine and lecturer in pharmacology, has been made chairman of the division of pharmacology at the University of California Medical School, San Francisco. He has been appointed to succeed Dr. Chauncey D. Leake, who recently became dean of the Medical School at Galveston of the University of Texas.

DR. LEO S. MASON, head of the department of chemistry at the North Texas Agricultural College, has been appointed assistant professor of chemistry at the University of Pittsburgh and senior research fellow in physical chemistry. Dr. Bernard F. Daubert, assistant professor of chemistry on leave from the College of Pharmacy of the University of Pittsburgh, has been appointed senior fellow in biochemistry at the university.

THE National Research Council announces the appointment of Dr. Douglas M. Whitaker, of the department of biology of Stanford University, as executive secretary of the Division of Biology and Agriculture. Dr. Whitaker will aid in coordinating research in biology and agriculture in relation to the war effort.

DR. THORNE M. CARPENTER, acting director of the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, has been appointed director of the laboratory.

DR. ALFRED E. EMERSON, professor in the department of zoology at the University of Chicago; Dr. Charles H. Seevers, head of the department of zoology at the Central Young Men's Christian Association College of Chicago, and Alex K. Wyatt, a specialist in moths and butterflies, have become honorary associates in entomology on the staff of Field Museum of Natural History.

FREDERICK D. RICHEY, of Ashville, Ohio, has been appointed a member of the Division of Cereal Crops and Diseases of the Bureau of Plant Industry, with headquarters at Knoxville, Tenn. He will act as coordinator for the regional corn improvement program in the South, and direct the state corn program cooperative between the Tennessee Agricultural Experiment Station and the U. S. Department of Agriculture.

DR. WILBERT MCLEOD CHAPMAN has resigned his position as director of the Washington State Shellfish Laboratory to become curator of fishes in the California Academy of Sciences, San Francisco.

DR. H. H. FOSTER, plant pathologist at the Tobacco Institute of Puerto Rico, has been appointed plant pathologist at the Truck Crops Experiment Station at Crystal Springs of the Mississippi Agricultural Experiment Station. George Y. Young, assistant plant pathologist of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, has been transferred to the department of plant pathology at State College, Miss., where he will undertake investigations on diseases of corn.

BRYAN PATTERSON has been appointed curator of the division of paleontology at Field Museum of Natural History, Chicago. He has been acting curator since the retirement last year of Elmer S. Riggs, and had been previously assistant curator.

DR. ROBERT S. SHELTON has been promoted to the position of scientific director of the Wm. S. Merrell Company, pharmaceutical manufacturers of Cincinnati. He will be responsible for activities relating to research and product improvement. L. Dale Seif becomes chief chemist, and will have charge of all analytical and control work. Dr. L. V. Blubaugh has been made chief of the biological research and production departments.

DR. L. GRANT HECTOR, professor of physics at the University of Buffalo, has resigned to become director of engineering for the National Union Radio Corporation, of Newark, N. J.

DR. RICHARD S. UHRBROCK, head of the research department in the Industrial Relations Division of the Procter and Gamble Company, Cincinnati, has been appointed consultant in the training within industry program of the War Manpower Commission by Chairman Paul V. McNutt. He is developing a program for the selection of new supervisors in organizations holding war contracts.

PROFESSOR E. R. BECKER, of the department of zoology of Iowa State College, has been commissioned a captain in the Sanitary Corps of the U. S. Army.

DR. EUGENE W. SCOTT, research assistant at the Kettering Laboratory of Applied Physiology, Univer-

sity of Cincinnati, has been appointed gas officer in the Medical Division of the Office of Civilian Defense, Washington, D. C.

RICHARD F. FLINT, associate professor of geology at Yale University, an authority on glaciation, has leave of absence to accept a commission as a major in the Army Air Corps. He has been given an assignment concerned with the Arctic area with the Proving Ground Command of the Army Air Forces. His previous experience included work as senior scientist on the Byrd Expedition to Greenland in 1937, where he studied the glaciers and submarine connections between the Spitzbergen Islands and Greenland and journeyed within six hundred miles of the North Pole.

DR. HAMILTON SOUTHWORTH, assistant in medicine in the College of Physicians and Surgeons, Columbia University, has joined the staff of the Medical Division of the Office of Civilian Defense as a member of the Scientific Development and Research Section. Dr. Southworth will go to London shortly to represent the Medical Division as an intelligence officer. He has been commissioned in the U. S. Public Health Service in the grade of surgeon.

DR. FRANK E. EGLER, director of the Chicle Development Company Experiment Station and assistant professor on leave from the New York State College of Forestry, has been made senior dendrologist in the U. S. Forest Service, a war service appointment on the recently established Latin American Forest Resources Survey. He may be reached at the American Legation, San Jose, Costa Rica.

LLEWELYN WILLIAMS is leader of an expedition to make a survey in Peru in search of new supplies of cinchona bark.

DR. EUGENE L. OPIE, director of the department of pathology, Cornell University Medical College, New York, will deliver the second Edwin R. Kretschmer Memorial Lecture of the Institute of Medicine of Chicago on February 26. His subject will be "The Experimental Production of Leukemia and Its Significance in Relation to the Human Disease."

DR. WILLIAM J. ROBBINS, director of the New York Botanical Garden, will deliver the fifth Harvey Society lecture of the current series at the New York Academy of Medicine on February 18. Dr. Robbins will speak on "Some Internal Factors Limiting Growth."

LIEUTENANT COLONEL PAUL F. RUSSELL, U. S. Army, chief of the Tropical Disease and Malaria Control Section of the Division of Preventive Medicine, Office of the Surgeon General, Washington, D. C., will deliver the annual Hermann M. Biggs Memorial Lecture on April 1 at the New York Academy of Medicine. His subject will be "Malaria and Its Influence on World Health."

DR. ROBERT CUSHMAN MURPHY, of the American Museum of Natural History, gave on January 20 the Schiff Foundation Lecture at Cornell University, Ithaca. With the aid of kodachrome motion picture films, the speaker discussed the marine investigations of the Diesel schooner *Askoy* in the Pacific west of Colombia, during the first half of 1941, and also described many aspects of geographic and historic interest along the little known Chocó coast between southern Panama and northwestern Ecuador.

THE *Journal* of the American Medical Association reports that the Academia Nacional de Medicina of Buenos Aires has established the Hirsch Medical Scholarships with a fund of 500,000 pesos (about $125,000) given by Alfredo Hirsch of Buenos Aires. The work of these scholars will be carried out in the United States or in England for two years beginning by the middle of 1943. For the first ten years the scholarships will be given for studies on cancer, leprosy or infantile paralysis.

DISCUSSION

FURTHER COMPUTATIONS IN CHEMICAL PROGRESS

THE curve of chemical progress, based on the abstracts in *Chemical Abstracts,* and first published in SCIENCE for February 14, 1936, when prolonged to bring it up to date, shows important changes in slope. These changes in slope seem to indicate a close tying up of peaceful living with progress.

The full curve, shown in Fig. 1, like the curve published in 1936, is based wholly on the number of journal articles on chemistry indexed each year by the editors of *Chemical Abstracts.* Thus a little less than 8,000 journal articles were indexed in 1907, about 2,000 more the next year, and so on until 1913, when a little over 19,000 were indexed. Then the number dropped at a somewhat faster rate until 1918.

In 1919 the curve resumed its upward course at the old rate of a 2,000 increase each year, continuing, with two breaks which must be noted and explained, until a peak of almost 46,000 was reached in 1938, more than five times the rate of progress in 1907.

The curve turned completely in 1938 and plunged downward until it reached 31,000 (estimated in part) for 1942.

In other words, the present war has wiped out the growth of chemical progress during the last eight years, setting chemistry almost back to the year 1929.

Under the headline "Pure Science Held up by War," the *New York Sun,* October 21, 1942, explained how the Smithsonian Institution has turned away from its path of peaceful days when it "devoted itself to the furthering of fundamental knowledge, much of which has had little practical significance at the moment, but which has produced a secure foundation for practical development."

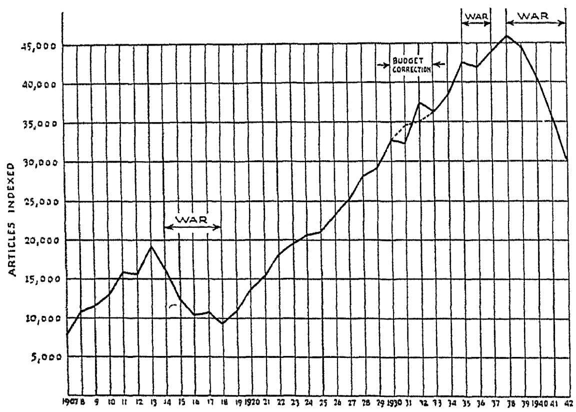

FIG. 1

During the war this work "must be temporarily suspended," and the staff of almost 100 scientists has been coordinated for the work of answering scientific inquiries sent in by the military, drawing the answers from "accumulated knowledge." Thus there have been no research results to publish from the Smithsonian Institution, to take it as one example of the effect of war on scientific progress.

The apparent drop at the year 1931 is apparent only. The budget makers mistakenly assumed that the financial depression, beginning in 1929, would begin to show in diminishing journal articles by 1931, and therefore they restricted the budget of the *Chemical Abstracts* editors in that year.

No such diminishing of journal articles appeared and 2,500 journal articles were held over from 1930 for indexing until 1931. The dotted line crossing 1930 makes this correction for the 2,500 held over so that the curve becomes practically straight until it drops slightly in 1936, the year Italy conquered Ethiopia.

Apparently the threatening war clouds of that year, 1936, adversely affected chemical progress nearly as much as the war clouds affected it in 1939.

One added phenomenon seems worth mentioning, and that is the parallelism between chemical progress and mechanical progress. The ratio of chemical patents to mechanical patents issued in the United States has not altered greatly in many years. For the last year, with wide fluctuations, the issue of chemical patents has averaged about 10 per cent. of all patents issued, as against 7 to 8 per cent. in the thirty years preceding 1936. The obvious inference is that war affects mechanical and chemical progress alike, and now seems to be adversely affecting mechanical progress a little more severely than it affects chemical progress.

To those who set up the theory that wartime progress is kept secret for some years and is published later the answer is that no such phenomenon can be deduced from the curve following the year 1919. The oft-repeated statement that war helps progress is true only in a few very narrow fields where industry learns to turn to hitherto unused sources of information, such as Smithsonian Institution, and profits by that information.

For the most part, research organizations, in wartime, are weakened or the experts are put on inspection work or are set to work in unfamiliar fields, so that less progress becomes possible.

JOURNAL ARTICLES ABSTRACTED ANNUALLY IN CHEMICAL ABSTRACTS

Year	Numbers of Abstracts	Year	Numbers of Abstracts
1907	7,975	1925	20,951
1908	10,835	1926	23,103
1909	11,455	1927	25,037
1910	13,006	1928	28,153
1911	15,892	1929	29,083
1912	15,740	1930	32,731
1913	19,025	1931	32,278
1914	16,468	1932	37,403
1915	12,290	1933	36,139
1916	10,519	1934	38,371
1917	10,921	1935	42,593
1918	9,283	1936	41,927
1919	10,957	1937	44,032
1920	13,619	1938	45,917
1921	15,211	1939	44,414
1922	18,070	1940	40,624
1923	19,507	1941	35,588
1924	20,523	1942	30,479

EDWARD THOMAS

WOOLWORTH BUILDING,
NEW YORK, N. Y.

SYNCHRONY IN FLOCK WHEELING

THE problem of the synchronization of action of cells and organisms has long attracted the interest of biologists. Separate units often respond with such simultaneity or under such other conditions that, in the case of neurones, ordinary conducted nerve impulses seem to be excluded.[1,2,3] Similarly with the behavior of organisms—insect flashes,[4] plant blooming, fish wheeling, and the like.[1,5]

[1] R. W. Gerard, *Scientific Monthly,* 44: 48–56, 1937.
[2] R. W. Gerard, *Ohio Jour. Science,* 41: 160–172, 1941.
[3] R. W. Gerard, *Annual Review of Physiology,* 4: 329–358, 1942.
[4] R. Ruedeman, SCIENCE, 86: 222–3, 1937. G. Alexander, SCIENCE, 82: 440–1, 1935. H. A. Allard, SCIENCE, 82: 517, 1935.

Some time ago an opportunity presented which enabled me to time the wheeling of a small bird flock with considerable precision. As I drove along a Vermont hilltop road at 35 miles per hour, the speed noted by chance just at the right time, a flock of something under half a hundred birds flew parallel to me not over fifteen feet from the car window and at precisely my speed. After a few seconds of this the flock wheeled away—not columns left, but each individual left face. I could not detect the slightest shift of position of one individual relative to the group. Surely none continued forward anything like its own length, perhaps 9 inches, after the others had turned.

Flying at 35 miles per hour, a bird lagging only ten milliseconds behind its fellows would have shot six inches ahead before making the turn. Clearly all the birds swerved simultaneously, within a maximum variation of less than five milliseconds.

What the cue or signal was which initiated the group maneuver, I do not know. No leader moved first and was followed by the others—I could not have failed to see the sequence. And any optic or even auditory stimulus, with a probable minimal reaction time of at least 100 milliseconds, must have acted with extreme constancy on the separate individuals. Even the Rockettes, elaborately trained to pretimed movements, can not approach such precision.

R. W. Gerard

Department of Physiology,
University of Chicago

SCHOOLCRAFT AND THE AMERICAN ETHNOLOGICAL SOCIETY

In recent issues of Science, there are some interesting articles about the American Ethnological Society in which Albert Gallatin has been mentioned as its founder. The centennial of this organization seems a proper time to consider the suggestion that Schoolcraft should be given at least joint credit for its establishment.

Schoolcraft had a genius for the construction of vehicles for scholarly activity, first manifested at the age of sixteen at Guilderland, N. Y., and afterwards wherever he went.

The last words in his first book, published in New York City in 1819, emphasized the need of a society for the study of antiquities in the United States ("A View of the Lead Mines of Missouri," p. 294).

In the spring of 1825, again while visiting in New York City, he, with Mr. Conant and Mr. Dwight, definitely arranged for a magazine devoted to Indian subjects, with Wilder and Campbell, publishers ("Memoirs," p. 207).

Disappointed in this, in December of the same year, at Sault Ste. Marie, Mich., Schoolcraft began a literary-ethnological magazine of his own, in manuscript, which circulated not only in that military outpost but considerably in the East as well.

In 1832, in Detroit, he organized the ethnological-humanitarian Algic Society, whose activities centered wherever he went and did not survive his interest.

Credit for establishment of the first common school journal in the United States, published in Michigan, 1838–1839, was originally given to John D. Pierce, then state superintendent of public instruction. It has now been shown that the launching influence in this was Schoolcraft, whose committee chose Mr. Pierce for editor and publisher because of the prestige of the latter's position as well as his ability.

The great Lewis Cass for years has been proudly claimed as founder of the Historical Society of Michigan. Now it has been made clear that, although deeply interested in scholarly matters, Governor Cass manifested no organizational urge for the better part of two decades of residence in Michigan; but that the Historical Society of Michigan sprang into being within a few weeks after Schoolcraft arrived in Detroit, in 1828, as a member of the Territorial Legislative Council. Schoolcraft secured for the organization its state charter and the potent name of Cass for its first president; and made all members of the legislative council members *ex officio* in order to give the society official countenance and secure a place of meeting for it.

Late in 1841 Schoolcraft left Michigan for New York City. The middle months of 1842 he spent in Europe, where he contacted and was particularly interested in scholarly organizations (manuscript paper, "Scientific Associations Abroad," in files of New-York Historical Society). On his return from Europe in 1842 he settled in New York City. Immediately the American Ethnological Society was founded—in November of that year.

The distinguished Albert Gallatin had been in New York City since 1828.

A contemporary biographical sketch of Schoolcraft, published unquestionably with his approval, says that "in 1841 he removed his residence from Michilimackinack to the city of New York, where he was instrumental, with Mr. John R. Bartlett, Mr. H. C. Murphy, Mr. Folsom and other ethnologists, in forming the American Ethnological Society—which, under the auspices of the late Mr. Albert Gallatin, has produced efficient labors" ("Memoirs," xlv).

It would appear that, in the case of the American Ethnological Society as so often, Schoolcraft again had hitched his vehicle for scholarship to a starry

[5] W. C. Allee, "Animal Aggregations," University of Chicago Press, 1931.

individuality, thereby conspicuously advancing scientific interests but obscuring his own all-important part in the procedure.

Full consideration might find it just henceforth to give Schoolcraft at least joint credit with Gallatin for the foundation of the American Ethnological Society.

CHASE S. OSBORN
STELLANOVA OSBORN
POSSUM POKE IN POSSUM LANE,
POULAN, WORTH COUNTY, GEORGIA

SPECIAL CORRESPONDENCE

WOUND HEALING

DR. S. PILIPCHUK, executive secretary of the Moscow Soviet Scientists Anti-Fascist Committee, has sent to SCIENCE the following communications by wireless from Moscow.

HEALING WOUNDS BY SKIN TRANSPLANTATION

Wound healing by the method of transplanting tissues evolved by Academician Filatov and his school is now widely practised. Particular attention has been attracted by the work of Professor Krause (Saratov) who has applied dead tissues chemically treated with chloraclyde in the healing of fresh and granulated wounds and chronic ulcers. Experience has shown that transplanted chloraclyde-treated tissues have the same, and in some cases even better, curative action. For grafting, Professor Krause has suggested using preserved skin from dead bodies and later chemically treated animal tissues, while his assistant Levkov uses the pericarpoidal [pericardial?] membrane treated the same way.

Hundreds of transplantations made in the Saratov Hospital on chronically non-healing ulcers, fistulas, burns, frostbite, skin diseases and in corneal lesions yielded excellent results in practically all instances. Surgical Clinic Pikin, candidate for the degree of doctor of medical sciences, has applied Professor Krause's method, using chemically treated pericarpoidal [?] skin from corpses and animal abdominal tissues. Careful preparation of transplanted skin is of the utmost importance. After being sprayed with chloraclyde solution the wound is drained, then sprayed again with chloraclyde. A piece of skin of the same form and shape as the wound, but slightly smaller than its surface area, is laid on the wound and fixed by several ligatures. This is covered by dry aseptic dressings. Pain in patched wounds ceases in from one to three hours after transplanting the skin. Healing takes less time under the grafted skin than in ordinary aseptic treatment. The bandage remains dry, and the scar remaining when the healing process is complete is small, soft and mobile.—N. EGOROV.

STIMULATION OF WOUND HEALING

Professor Goldberg, who holds the chair of pathological physiology in the Tomsk Medical Institute, suggests embryonal emulsion in the form of a liquid ointment made on a castor oil base for stimulation of the healing processes in wounds. Embryos are taken from guinea pigs, divided with scissors, and carefully ground with a small quantity of sterilized castor oil. Zeroform is added in the ratio of 0.3 parts to every 100 cc of oil. Tests made with this ointment on trophic ulcers in the Tomsk surgical clinics and hospitals prove that during the second phase of wound healing, and also when the process is sluggish, when granulation is either absent or poorly developed and there is sluggish regeneration of epithelium, this ointment has definite beneficial effect. This is frequently apparent after one or two dressings. It has an unquestionable stimulating influence on the regeneration of epithelium.—N. EGOROV.

MESSAGE RECEIVED BY THE AMERICAN ASSOCIATION OF SCIENTIFIC WORKERS FROM THE SOVIET SCIENTISTS ANTIFASCIST COMMITTEE

WE have received your letter of greetings through Professor Propper-Grastchenkov. Your proposal to establish closer contact between American and Russian scientists has met with greatest approval among Soviet men of science.

Soviet scientists are struggling for freedom and independence of all nations and for preservation of science and culture. . . .

In the struggle being waged by the democratic countries against fascist reaction science and technique play an important part. Soviet scientists spare no efforts in helping the Red Army to hasten the complete defeat of Hitlerism.

Several conferences were held in our country recently at which the work of scientists in wartime was discussed and plans for new efforts outlined. At the Jubilee Session of the Academy of Sciences of the USSR, convened in November, the results of scientific endeavor during the quarter century of Soviet power and the work of scientists in the war against Hitlerism were reviewed. Some time later there was a joint plenum of the medical councils of the People's Commissariat for Health of the USSR and of the Commissariat for Health of the RSFSR. The session of the Lenin All-Union Academy of Agricultural Sciences met in December.

At all these conferences a summary of what was done in each respective field of science was discussed and plans for further work in the war effort drawn up.

We believe that the exchange of reports on the

scientific activities of our freedom-loving countries would help to consolidate and widen our contacts. With this view in mind, we are in a position to despatch articles by Soviet scientists to American scientific journals.

Best New Year greetings to our American colleagues, wishing the American people success in hastening the defeat of Hitler's bands.

(Signed)

NIKOLAI DERZHAVIN,
President, Soviet Scientists Anti-fascist Committee
SERGEI PILIPCHUK,
Secretary

SCIENTIFIC BOOKS

THE "PIROTECHNIA" OF BIRINGUCCIO

The Pirotechnia of Vannoccio Biringuccio. Translated from the Italian with an introduction and notes by CYRIL STANLEY SMITH and MARTHA TEACH GNUDI. Publication sponsored by the Seeley W. Mudd Memorial Fund. xxviii + 476 pp. 92 illustrations. $7\frac{1}{2} \times 10\frac{1}{2}$ inches. New York: The American Institute of Mining and Metallurgical Engineers, 1942.

THE present century has witnessed an awakening of interest in several classic metallurgical treatises, as is indicated by the appearance of English translations of four important works of the sixteenth, seventeenth and eighteenth centuries. The first of these was the publication in 1912 by Herbert C. and Lou H. Hoover of their splendid translation of the first 1555 Latin edition of the "De Re Metallica" of Georgius Agricola. The second of these works was the translation in 1913 of "El Arte de los Metales" of Alvaro Alonso Barba by R. E. Douglass and E. P. Mathewson from the Spanish edition of 1640. The third of this group of treatises was the publication in mimeograph form in 1938 by the British Non-Ferrous Metals Research Association of the long-neglected translation by Arthur H. Searle of Emanuel Swedenborg's "Regnum Subterraneum, sive Minerale de Cupro et Orichalco" from the first Latin edition of 1734. The present English translation of the "Pirotechnia" of Biringuccio from the first Italian edition of 1540 is the fourth and latest member of this series of important historic metallurgical publications.

In the Introduction to the present edition of the "Pirotechnia" Dr. Gnudi gives first a two-page sketch of Biringuccio, who was born at Siena in 1480 and after a most adventurous life as a smelter and worker in metals died in 1538 or 1539. Dr. Smith then follows with a most interesting thirteen-page discussion of "The Background of the Pirotechnia and its Place in Metallurgical Literature" and of "The Editions of the Pirotechnia." The present edition, he remarks, "is the result of collaboration of two individuals whose chief fields of activity have been, respectively, in Italian literature and in metallurgy." Dr. Gnudi concludes the Introduction with two pages of remarks upon some of the problems encountered in making her translation.

The general scope of Biringuccio's "Pirotechnia" (by which was meant not so much pyrotechnics as pyrotechny in the broader sense of the use of fire in the mechanic arts) is indicated by the following brief synopsis of the ten books of the translation:

Book 1. Ores of gold, silver, copper, lead, tin, iron and making steel and brass.
Book 2. Ores of quicksilver, sulphur, antimony, vitriol, alum, arsenic and other so-called semiminerals.
Book 3. Assaying and preparing ores for smelting.
Book 4. Separation of gold from silver.
Book 5. Alloys of gold, silver, copper, lead and tin.
Book 6. Art of casting guns and objects of bronze such as bells.
Book 7. Methods of melting metals.
Book 8. Special methods of casting and moulding.
Book 9. Arts of alchemy, distilling, minting, metal working, extracting, etc. and of making wire, metallic mirrors, crucibles, pottery, lime and bricks.
Book 10. Manufacture of saltpeter, gunpowder, mines, bombs, etc. and fireworks for purposes of war and festivals.

To the ninety-nine strictly technical chapters, which make up the ten books of his Art of Fire, Biringuccio, for the sake of full measure, has added a final curious allegorical one hundredth chapter on the fire of love; "it consumes without leaving ashes, it is more powerful than all other fires, its smith is the great son of Venus, and its instruments, in place of glowing melting furnaces, bellows, hammers, and anvils, . . . are naught but quarrels, jealousies, fears and many other great and annoying agencies."

In addition to the flashes of wit and humor that appear here and in other pages of Biringuccio, the reader is impressed not only by the up-to-dateness of some of his descriptions of processes but also by the sagacity and common sense with which in an age of superstition he disposes of those who trust in divining rods, or in other magical devices, for locating mineral deposits, in the efficacy of which there are even now some believers. As for those who sought to produce precious metals by transmutation Biringuccio re-

marks: "I tell and advise you that I believe the best thing to do is to turn to the natural gold and silver that is extracted from ores rather than that of alchemy, which I believe not only does not exist but also, in truth, has never been seen by anyone, although many claim to have seen it." Similarly without arguing the matter he dismisses those who proclaimed the possibility of artificially creating human, or animal, or vegetable life by simply stating: "I cannot forbear saying that I do not believe them."

The present scholarly work of Drs. Smith and Gnudi will be all the more appreciated by both student and book collector for the reproduction of the title page of the first 1540 edition (interesting for its marginal engravings of apparatus) and for the eighty-four 2 × 4 inch reproductions of the original wood cuts of equipment and processes. In Appendix A are eight additional reproductions of drawings from Agricola and other authors to illustrate several of Biringuccio's descriptions. Appendix B gives an explanation of the weights and measures used by Biringuccio. Appendix C contains a list of the editions of the Pirotechnia. Appendix D is a bibliography of important metallurgical works with mention of English translations when such are known. An index of ten pages is also provided.

The typographic work of this edition, by Carl Purington Rollins at the printing office of the Yale University Press, is of the highest quality. As for the edition itself the reviewer can only repeat what Harvey S. Mudd, of the Seeley W. Mudd Memorial Fund Committee, has stated in his Foreword.

> Biringuccio's work is a classic and in its translation Dr. Smith and Dr. Gnudi have brought to bear the high degree of scholarship that it deserves. Dr. Gnudi made the translation at Dr. Smith's request and it was then refined "in the fire" of his scientific knowledge of the subject. The result is a book which the Institute is proud to place before its members and which the Memorial Fund Committee considers it a privilege to publish.

The book is one which should be read, and if possible owned, by all metallurgists and chemical technologists as well as by all students of the history of metallurgical arts.

C. A. BROWNE

CHEMISTRY

Introductory Chemistry for the Laboratory. By ALFRED BENJAMIN GARRETT, LAURENCE QUILL and FRANK HENRY VERHOEK. 239 pp. Ginn and Company. 1942. $1.60.

THIS manual contains 61 exercises, each of which will require two to four hours for performance and answering questions. The exercises are grouped into 14 units of related experiments, such as the gases of the air (Unit No. 1), acids (No. 3), the chlorine family (No. 6), compounds of sulfur, nitrogen, carbon (Nos. 9, 10, 11). An excellent unit is No. 12, raw materials for the inorganic chemical industries, which includes formation of useful compounds from natural carbonates, chlorides, sulfates, silicates and phosphates. Unit No. 13, metallurgy and reactions of some common metals, contains a few such interesting projects but consists mostly of test-tube reactions of metal salt solutions. Unit No. 14 consists of interesting applications of chemical principles—to water hardness, blueprinting, alloys, colloids, milk, butter, vinegar, baking powder, etc.

There is a wide choice of topics and ample opportunity for rearrangement for use with any text. There are a few quantitative experiments; this reviewer would prefer more. Appendixes I, II and III deal with fundamental techniques, weighing and elementary glass working, and since they are used immediately might well have been made into preliminary experiments. Most of the test-tube reactions are carried out on a semi-micro scale. An incongruity appears in the description of the "brown ring" test (p. 113) where five drops of nitrate and ferrous solutions are mixed in a small test-tube and five drops of concentrated sulfuric acid added; the accompanying diagram shows the acid being poured from a large wide-mouthed bottle.

The book is paper-bound, with the sheets perforated and punched for reassembling with rings. Each sheet has a blank for the student's name, and blanks are provided for answers to all questions. The printing is good, and there are few errors.

Semimicro Laboratory Exercises in General Chemistry. By J. AUSTIN BURROWS, PAUL ARTHUR and OTTO M. SMITH. xiii + 328 pp. The Macmillan Company. 1942. $2.50.

THIS laboratory manual is exceptionally well written, and the care, experience and interest of the authors in the student's progress are evident throughout. It introduces real semi-micro procedures from the start, with adequate directions, but does not hesitate to use small-scale macro-methods when this seems advisable. The saving in materials and time should be considerable, and the advantage of collecting 12 ml vials of dangerous or obnoxious gases instead of larger amounts is obvious. The experiments are thoroughly workable and most students should be stimulated by the careful but not at all difficult technique required.

The reviewer can do no better than to quote from the preface: "Balance has been maintained between descriptive experiments, quantitative experiments, experiments illustrating . . . laws and principles, and experiments illustrating applications of chemistry."

"The seventy-two exercises offer a wide variety of experiments from which the teacher . . . may choose a suitable number of almost any desired type." "Practical applications . . . are brought out here and there . . . to reveal to the student that chemistry is related to his personal existence." "More and more responsibility is thrown upon the student as he progresses from the earlier experiments to the later ones."

The description of materials and solutions required is complete and adequate. Each experiment has a set of "Preparatory Questions" for preliminary study, the "Procedure" with notes calling for observations to be written down and used as a guide in filling in blanks in the "Interpretation" pages, which are to be torn out and handed in. The whole book is paper-covered, with spiral binder, and all sheets are perforated and punched for reassembly with rings. The format is good, and there are few if any errors.

CECIL V. KING

SPECIAL ARTICLES

STUDIES ON THE ISOLATION OF THE FACTOR RESPONSIBLE FOR TISSUE INJURY IN INFLAMMATION[1, 2]

CAREFUL analysis of the various manifestations of inflammation reveals an essentially stereo-patterned reaction, irrespective of the causative irritant. The latter as well as the anatomical location of the lesion may influence the ultimate appearance of the inflamed area; but close scrutiny reveals the presence of a basic pattern.[3, 4, 5] This is characterized first by an increased fluid passage primarily referable to the liberation of leukotaxine. This substance as shown in earlier studies increases capillary permeability.[3] The alteration in the structure of the capillary endothelium allows the free passage of plasma proteins, including fibrinogen. The latter in the presence of injured tissue is precipitated as a fibrinous network.[3] The tributary lymphatics being evidently more delicate in structure than the capillaries are damaged at a relatively early stage, becoming thus occluded with fibrinous thrombi. The presence of coagulated plasma at the site of inflammation in addition to the occlusion of the tributary lymphatics induce, a lymphatic blockade which thus "walls-off" the inflammatory irritant. In this way inflammation as shown in a number of earlier studies plays an important rôle in immunity as a regulator of bacterial invasiveness.[6] Subsequently, polymorphonuclear leukocytes appear on the scene. Chemotaxis of these phagocytic cells is brought about by the liberation of leukotaxine.[3] Thus this substance is responsible for two of the basic sequences in the development of the inflammatory reaction, namely, increased capillary permeability and migration of polymorphonuclear leukocytes. The usual cytological sequence of polymorphonuclear leukocytes followed eventually by macrophages is conditioned by the local pH at the site of inflammation.[7] The developing local acidosis is in turn referable to a disturbance in the local intermediary carbohydrate metabolism.[8] The rise in number of circulating leukocytes is due to the liberation of a pseudo-globulin in the exudate. It has been termed the *leukocytosis-promoting factor*.[9] The interplay of the foregoing sequences ultimately disposes of the irritant and allows unhampered regeneration or repair.

In the last analysis the inflammatory reaction is a manifestation of severe cellular injury. Neither leukotaxine nor the leukocytosis-promoting factor induce the characteristic injury of inflammation. Besides the function ascribed above to these two substances, there is as a result of their presence in normal tissue scarcely any detectable cellular injury. An attempt has therefore been made now to identify the factor responsible for injury *per se*. Studies have been undertaken on the pleural exudates of dogs obtained as a result of turpentine injection. The results have been further substantiated by additional studies on exudative material obtained from man. In brief, it has been found that either dialysis of the exudate or its fractionation with usually one-third saturation of ammonium sulfate yields, after removal of the $SO_4^{=}$ by dialysis, a potent euglobulin fraction which rapidly induces severe tissue damage in rabbits and to some extent in dogs. The induced inflammatory reaction is characterized after a few hours not only by marked leukocytic infiltration but also by massive thrombosis both of lymphatics and to some extent of the small blood vessels. There is also present a fibrinous network in the tissue distended with edema. The presence of the elements inducing lymphatic blockade, which in themselves serve as a gauge of the degree of local injury, is fully substan-

1 From the Department of Pathology, Harvard University Medical School, Boston, Massachusetts.

2 Aided by a grant from the Jane Coffin Childs Fund for Medical Research and under a Government Contract from the Office of Scientific Research and Development.

3 Valy Menkin, ''Dynamics of Inflammation,'' Macmillan Company, New York, 1940.

4 *Idem*, ''Medico-Surgical Tributes to Harold Brunn,'' University of California Press, 1942, p. 275.

5 *Idem*, *Physiol. Rev.*, 18: 366, 1938.

6 *Idem*, *Am. Jour. Med. Sci.*, 190: 583, 1935.

7 *Idem*, *Am. Jour. Path.*, 10: 193, 1934.

8 Valy Menkin and C. R. Warner, *Am. Jour. Path.*, 13: 25, 1937.

9 Valy Menkin, *Arch. Path.*, 30: 363, 1940.

tiated in numerous observations on rabbits. The introduction of trypan blue in an area of the axillary region, previously treated with the euglobulin fraction of exudate, is invariably followed by prompt local fixation of the dye as indicated by its inability to diffuse to the tributary lymphatic vessels and nodes. The introduction of the material in the cutaneous tissue of the abdomen of rabbits may or may not be accompanied by prompt local seepage of trypan blue previously injected intravenously; but in any case, contrary to leukotaxine, there is no diapedesis of leukocytes within the customary testing interval of approximately one hour. The collagenous material in such subcutaneous areas tends to be swollen and often appears somewhat ground-glass-like in appearance. The lymphatic blockade can be induced as early as about a half hour after the introduction of this protein substance. The material is thermolabile and non-diffusible. It can be dried by freezing in a Flosdorf-Mudd apparatus. The potency of the material is not appreciably reduced by the procedure. Some degree of fixation and manifest inflammation has been obtained following the injection of three milligrams of the desiccated material. The injection of this powerful substance obtained either from canine or human exudates is characterized, in the gross, in rabbits by intense redness, edema and frequent central necrosis. The tributary lymphatic nodes are usually erythematous and congested. The acute inflammatory reaction can not be elicited either by the pseudo-globulin (*i.e.,* the leukocytosis-promoting factor) or the albumin fraction of exudates derived from dogs or man. This fact, therefore, indicates that it is not the injection of foreign proteins into rabbits which is primarily responsible for the response. Furthermore, the effect can to a large extent be elicited by injecting the canine material into the cutaneous tissue of a dog. Finally, the acute reaction is not essentially referable to the insolubility of the euglobulin fraction, for it can be suspended as a very fine suspension in physiological saline. The injection of such a preparation elicits in the rabbit a similar effect accompanied by lymphatic blockade. As control for these findings similar fractions were obtained by treating the blood serum of dogs in precisely the same manner. It was found that fractionation or short-time dialysis of clear straw-colored serum yields a euglobulin fraction which, even though insoluble, is incapable of inducing in the rabbit a severe inflammatory reaction accompanied by lymphatic blockade. Trypan blue injected into such treated areas freely diffuses to the tributary lymphatics. Sera, however, containing large quantities of hemolyzed material or highly lipemic sera are apt to yield euglobulin fractions capable of inducing variable degrees of fixation of the dye. These facts suggest that the active fraction recovered from exudates is liberated from injured cells. Furthermore, it has been found that prolonged dialysis of serum for a period of thirty-six hours or over may give rise to an active euglobulin fraction. This is an interesting fact in view of the observation of Chick,[10] reported a number of years ago. This investigator pointed out that following prolonged dialysis a certain amount of pseudo-globulin is converted into euglobulin. One wonders whether such converted material may not be analogous to the injury factor or active euglobulin recovered from exudates. The active substance is absent in normal serum, but it can often be extracted from the blood serum of an animal with a concomitant acute inflammation. This fact points definitely to the significance of absorbed toxic material from the site of acute injury.

The foregoing facts demonstrate the presence of an injury factor in inflammatory exudates. This factor is found in the euglobulin fraction. It is therefore either a euglobulin or at least it seems to be associated with this protein fraction. The presence of such a chemical unit in exudative material warrants for the sake of convenience a name for this active biological substance. The term "necrosin" is therefore tentatively suggested. The untreated exudate *per se* induces when injected into rabbits a severe edematous inflammation characterized by lymphatic blockade. Fractionation of the exudate has yielded in the euglobulin fraction necrosin capable by itself of reproducing in an even more marked manner (undoubtedly due to the concentration and purification of the material) a similar picture as the whole exudate. The recovery of necrosin from exudates offers a reasonable explanation for the injury pattern revealed in an inflammatory reaction.[11]

The biological implications of this substance are at present being studied. The detail of this study as well as its effect on lymphatic blockade will be published *in extenso* elsewhere. In brief, necrosin injected into the circulation does not seem to alter appreciably the blood pressure of a cat. Intravenous administration of necrosin in a dog is followed by a marked leukopenia accompanied by transient toxic manifestations such as vomiting and diarrhea. Utilization of this finding has recently been employed in the further purification of the leukocytosis-promoting factor. By eliminating the euglobulin or necrosin, an active non-toxic leukocytosis-promoting factor is thus

[10] H. Chick, *Biochem. Jour.*, 8: 404, 1914.

[11] The basic pattern of injury in the development of various types of inflammation suggests that the irritant *per se* induces direct injury to the cell. The resulting deranged metabolism of the cell liberates various by-products (*e.g.*, leukotaxine, the leukocytosis-promoting factor, and necrosin) which act as common denominators in the development of a fundamentally basic pattern in inflammation.

obtained. It is conceivable that the presence or liberation of necrosin will explain, in part at least, the leukopenia frequently accompanying inflammatory processes. Finally, necrosin hastens markedly the rate of coagulation of blood *in vitro*. Whether this fact is due to thrombokinase associated with necrosin in the latter's present state of purification remains to be seen. Repeated injections of necrosin subcutaneously into rabbits induce the formation of precipitin antibodies to this substance. The implication of this finding remains to be determined.

In conclusion, the demonstration of an injury factor in the exudates of dogs and man, as brought down in the euglobulin fraction, and termed *necrosin* suggests further studies both in regard to the biological properties and the chemical purification of this substance. These investigations will form the subject of future communications.

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COLD AGGLUTININS (AUTOHEMAGGLUTININS) IN PRIMARY ATYPICAL PNEUMONIAS[1]

THREE cases have been encountered recently in which acute hemolytic anemia occurred in patients with the prevalent type of primary atypical pneumonia of unknown etiology. In two of these patients, difficulties in determining the blood group led to the discovery of a reversible autohemagglutinin (cold agglutinin). In certain other cases phlebothromboses and pulmonary emboli occurred during the latter part of the illness or during convalescence. Further study revealed that the great majority of the patients with primary atypical pneumonia tested this season showed cold agglutinins in dilutions of serum or plasma ranging from 1:10 to over 1:10,000 at 0° C.

This preliminary report is made because of the possibility that the development of cold agglutinins may serve as a criterion for segregating some of the prevalent cases of primary atypical pneumonia until definite etiological agents are established. The mechanism producing the autohemagglutinins is not known.

The maximum titer of cold agglutinins (in most cases 1:160 or 1:320 at 0° C.) was usually obtained at or near the end of the febrile period, and a rapid decline in titer occurred during convalescence. High titers were usually but not always obtained in the clinically severest cases. Essentially the same titers were obtained in serum from clotted blood and in plasma from oxalated samples. No hemagglutination was noted when the same samples were examined at 37° C. and the titer of cold agglutinins (tested at 0° C.) was unaffected by adsorption at 37° C. with erythrocytes of each of the four major blood groups.

A few of the patients in whom cold agglutinins were demonstrated also developed complement fixing antibodies for psittacosis and for the meningopneumonitis virus,[2] but these tests were negative in most instances.

A slight increase in the osmotic fragility of the erythrocytes was noted in some instances, but this was of a significant degree only in one of the patients who had acute hemolytic anemia. Tests were negative for autohemolysins, cold hemolysins (Donath-Landsteiner test), and the hemolysis test with acidified serum (Ham[3]).

Although the three patients with hemolytic anemia all had received sulfathiazole or sulfadiazine and many of the others in whom cold agglutinins were demonstrated were also treated with these drugs, a large percentage of those showing increased concentrations of autoagglutinins did not receive sulfonamide therapy throughout the course of their illness.

A number of samples of serum obtained from cases of primary atypical pneumonia of unknown etiology during the 1941–42 season failed to show cold agglutinins after six or more months of storage at 5° C. It is not known, however, whether or not this property was originally present in these samples or, as yet, whether the present sera will retain the property after 6 months under these conditions. Control sera obtained from cases of pneumococcus pneumonia and a variety of other febrile illnesses, most of them under treatment with sulfathiazole or sulfadiazine, were also examined for cold agglutinins with almost uniform absence of the agglutinins above a dilution of 1:4.

A brief review of the literature indicates that true reversible cold hemagglutinins have been demonstrated in significant titer only very rarely in cases of pneumonia. They have been noted in a few cases of various liver diseases or blood dyscrasias and, in a few instances, have been associated with peripheral vascular manifestations.[4,5] The only other infectious disease in which cold agglutinins have been found regularly is trypanosomiasis.[6]

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2 These tests were carried out for us by Drs. Karl F. Meyer and Thomas Francis, Jr.

3 T. H. Ham, *Arch. Int. Med.*, 64: 1271, 1939.

4 R. P. McCoombs and J. S. McElroy, *Arch. Int. Med.*, 59: 107, 1937.

5 K. M. Wheeler, H. J. Gallagher and C. A. Stuart, *Jour. Lab. and Clin. Med.*, 24: 1135, 1939.

6 W. York, *Ann. Tropical Med. and Parasit.*, 4: 529, 1910.

7 Aided, in part, by a grant from the John and Mary R. Markle Foundation.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PRODUCTION OF PANTOTHENIC ACID DEFICIENCY IN MICE WITH PANTOYL-TAURINE

MUCH evidence is accumulating to show that compounds with highly similar chemical configurations may interfere with each other with respect to their effects on living cells. The initial observations on the competitive relationships between sulfonamides and p-aminobenzoic acid in their effect on growth of microorganisms have been abundantly confirmed and extended by such reports as that of McIlwain,[1] who showed that pyridine-3-sulfonic acid and its amide interfere with nicotinic acid metabolism in microorganisms; and of Snell,[2] who showed that the physiologically inactive sulfonic acid N-(α, γ-dihydroxy-β, β-dimethylbutyryl)-turine (pantoyl-taurine[3]) interfered with the metabolism of pantothenic acid by lactic acid bacteria and yeast, apparently by blocking the essential pantothenic acid away from its site of action. No adverse effect of pantoyl-taurine on growth was observed if excess pantothenic acid were added simultaneously to the culture. McIlwain[3] has secured similar results with this substance on pathogenic bacteria. No data have been published concerning the effect of this substance on animals.

Pantoyl-taurine is relatively inactive on single oral or intraperitoneal administration to small mammals. No effects are noted from single doses as high as two grams per kilo of body weight in mice and rats. However, on long continued daily oral administration of pantoyl-taurine at a dose level of two hundred milligrams per kilo of body weight, evidence of pantothenic acid deficiency may be noted. After three to four weeks of such daily administration, growth in standard strains of laboratory mice ceased, the hair became roughened and porphyrin deposits appeared on the whiskers. There were also characteristic behavior symptoms similar to those observed in direct pantothenic acid deficiency.[4] These results were secured on a diet of Purina Fox Chow. This ration contains adequate pantothenic acid for mice in the absence of pantoyl-taurine. It thus appears probable that pantoyl-taurine interferes specifically with the metabolism of pantothenic acid in animals, as it does with microorganisms.

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[1] H. McIlwain, *Brit. Jour. Exp. Path.*, 21: 136, 1940; *Nature*, 146: 653, 1940.
[2] E. E. Snell, *Jour. Biol. Chem.*, 141: 121, 1941.
[3] H. McIlwain, *Brit. Jour. Exp. Path.*, 23: 95, 1942.
[4] J. G. Sandza and L. R. Cerecedo, *Jour. Nutrition*, 21: 609, 1941.

A NEW FIXATIVE FOR ANIMAL TISSUES

A NEW general fixative, superior to any other so far tested, has been developed in connection with the routine toxicological work carried on in this laboratory. This solution not only fixes the tissues well, but it permits brilliant subsequent hematoxylin-eosin staining. It has the additional advantage of dehydrating the tissues as it fixes them.

Fixative:

Picric acid	5 parts
Isopropanol	55 "
Acetone	30 "
Acetic (glacial)	5 "
Formaldehyde (40 per cent. by vol. C.P.)	5 "

The length of fixation depends, as with other fixatives, on the size and nature of the tissues involved. From two hours to four days is recommended. Tissues have been left in this fixative for several days without apparent harm.

The tissues that are not imbedded in paraffin are stored in 70 per cent. isopropanol.

Since this solution fixes and dehydrates at the same time, it permits a direct transfer from the fixative to isopropanol. In general practice, tissues are trimmed and placed in the labeled cheesecloth "tea" bags in which they are transferred from one solution to another and through the paraffins until imbedded.

After fixation the tissues are washed in two changes of isopropanol (nearly absolute), one to two hours in each change. Then they are passed through three changes of dioxane, one to two hours in each change. The tissues are usually left overnight in the third change of dioxane. Infiltration is begun with two hours in a $\frac{1}{3}$ dioxane-$\frac{2}{3}$ paraffin mixture and completed in three changes of pure paraffin, one half to one hour for each, in a vacuum oven.

Tissues are sectioned from 4 to 7 microns thick. The picric acid is removed from the mounted sections with a 1.5 per cent. solution of ammonia hydroxide in 95 per cent. ethanol prior to staining.

M. ARDELLE CLEVERDON
STAMFORD RESEARCH LABORATORIES,
AMERICAN CYANAMID COMPANY

BOOKS RECEIVED

ANDREWS, ALBERT H. *Manual of Oxygen Therapy Techniques.* Pp. 191. The Year Book Publishers, Inc. $1.75.

BOWEN, E. J. *The Chemical Aspects of Light.* Illustrated. Pp. vi + 191. Oxford University Press. $4.00.

Carnegie Endowment for International Peace. Year Book, 1942. Pp. x + 152. Carnegie Endowment.

MABEE, CARLETON. *The American Leonardo, The Life of Samuel F. B. Morse.* Illustrated. Pp. xix + 420. Alfred A. Knopf, Inc. $5.00.

SCHUCHERT, CHARLES. *Stratigraphy of the Eastern and Central United States.* Illustrated. Pp. xvii + 1013. John Wiley. $15.00.

WEISS, EDWARD and O. SPURGEON ENGLISH. *Psychosomatic Medicine.* Pp. xxiii + 687. W. B. Saunders Company. $8.00.

SCIENCE NEWS

Science Service, Washington, D. C.

THE CITRUS FAMILY

THE citrus family has had its pedigree revised and brought up to date by a veteran Department of Agriculture botanist, Dr. Walter T. Swingle. Results of his studies, which are expected to be of considerable use to breeders developing new hybrids and to orchardists seeking hardier stocks for grafting, will be published soon in monograph form by the University of California Press, as part of a series of major scientific publications in celebration of the seventy-fifth anniversary of the founding of the university. Dr. Swingle's monograph constitutes the first complete reexamination of the citrus family tree since 1824.

Under the new arrangement, the family consists of 33 genera, only one of which, the genus Citrus itself, is extensively cultivated for its wide variety of edible fruits. However, any one of the 32 other Cinderella sisters in the group might, if managed correctly, assist in producing valuable new hybrids, or offer hardy roots on which present varieties of citrus fruits may be grafted. Furthermore, though these others do not at present produce edible fruits, some of them have good possibilities as ornamentals.

In working out the relationships of the many species in the family, Dr. Swingle made use of a radical new method of study. Ordinarily, a botanist studying pressed herbarium specimens examines the dried flowers whole, usually after picking one off and soaking it in water. This inevitably destroys a piece of the specimen; and often when there is only one specimen to be had, the herbarium curators are reluctant to let it go for this purpose.

Dr. Swingle, using a procedure pioneered in World War I days by a noted Swedish botanist at Upsala, embedded single flowers or buds in paraffin and sliced them into transparently thin specimens for examination under the microscope. One specimen was thus multiplied into scores. The method also made possible far more accurate and critical examination of anatomical details than was possible under the older procedure.

Since 1935, when he began his work on the reclassification of the citrus family, Dr. Swingle has accumulated more than a quarter-million such microscope-slide specimens, each keyed to connect it up with the original pressed plant on a herbarium sheet somewhere in one of the world's great museums or universities. The whole quarter million can, if necessary, be packed in a box of only three cubic feet capacity.

The citrus family has a curious geographic distribution. Its principal area stretches from Indomalaysia southeastward as far as Fiji. There are also a number of genera in Africa; none elsewhere in the Old World, and none at all in the Western Hemisphere.

TUNISIA

As Tunisian rainy season for early 1943 draws to a close, combat activities become possible in the semi-desert areas south and west of the seaport city, Sfax. January is usually the wettest month in this westernmost of French possessions in North Africa. Its rainy season is roughly from October to April. The other months are hot and dry—usually with little or no rainfall.

Southern Tunisia has little rain at any season. It is a desert area. Northern Tunisia is mountainous except for a flat coastal rim. The United Nations' fighting forces are in the mountainous country, the Axis on the coastal rim. American forces are reported to be in the northern part of middle Tunisia, the area stretching northward from the semi-desert country along the great salt-depression called Chott el Djerid, the largest of the salt-water lakes or chotts of Tunisia.

In the mountainous area are farms, grazing ranches, and timbered areas with growths of marketable evergreen oaks, Aleppo pines and cork trees. The olive groves for which Tunisia is famed are on the coastal rim from Sfax, which is to the northeast of the Chott el Djerid, northward to Tunis.

Mountainous middle and northern Tunisia is not an easy country for troop movements. It is a land of mountains and plains but without plateaus. It is rough and badly eroded in some sections. It is not supplied with good roads. Getting about in the rainy season is a mud-fighting job. But with new military roads constructed by the Army and with additional flying fields, the path is cleared to drive the enemy on the coastal plains into the Mediterranean.

It is a difficult country in which to obtain food and fighting equipment for an army. Considerable quantities of wheat and barley are produced, some of which are exported normally but not enough to be of much help in feeding the United Nations' troops. It produces many goats, considerable numbers of sheep, and some cattle. Goat meat is not included in the American army diet, and enough local mutton and beef can not be purchased to meet the needs.

Supplies of all kinds must be transported over a long and difficult road. They are brought by ships to Casablanca, and from there by standard-gauge railroad to western Tunisia. Then they must be reloaded onto narrow-gauge cars or army trucks for transportation to middle Tunisia. They are carried by railroad and highway a distance equal to half the distance from Washington, D. C., to Los Angeles. Some supplies and equipment are unloaded from shipboard at Algiers. Transportation from there is over the same standard-gauge and narrow-gauge railroads.

Shortage of railroads and highways i. Tunisia is due to the easy water transportation of the country. It has the Mediterranean on the north and on all of the productive east. It has many good harbors for medium-sized ships and one at Bizerte for the larg^st ships. But these ports are not yet available for the United Nations.

The small population of Tunisia and the rather simple life of the inland inhabitants have not required the transportation facilities necessary in certain other countries

where the people are more interdependent upon each other. Approximately three million inhabitants include about 2,400,000 natives, Berbers in the northern part and Arabs in the south. The 110,000 persons of French blood are largely in the north, as are also the 94,000 persons of Italian blood. There are many Negroes and mulattoes, and a so-called Moorish population. This is a mixture of all the races that have successively settled in Tunisia.

DISCOVERY OF RUBBER IN DECAYED BARK

CHANCE discovery of threads of good rubber in a bit of rotting bark in a Haitian forest may eventually mean restoration to favor of the Castilla rubber tree, once a prime source of the bouncy gum but displaced by Hevea because the latter could be tapped more successfully. That we can develop a method for mincing up Castilla bark and getting the bits of rubber out whole, as is now done with the guayule shrub, this disregarded tree may again become a practicable commercial source, is suggested by Dr. O. F. Cook, of the U. S. Department of Agriculture.

Hevea displaced Castilla as a plantation tree because it can be milked every day, whereas the latter tree yields copiously on the first tapping but after that "dries up" and gives no more latex. Harvesting Castilla rubber in the wild, therefore, resolved itself into a very destructive affair. The trees were cut down, the trunk and larger limbs ringed with cuts, and all the latex thus extracted at once. The dead trees were left to lie where they fell. If it proves possible to make an economic extraction of rubber from the bark, after taking the latex by the conventional tapping, the yield of Castilla may be increased to a point of economic justification.

There appears to be an enzyme in Castilla sap, which destroys the rubber if it has a chance to act on it. Dr. Cook suggests that this enzyme could be destroyed by heating, merely by building a light brush fire around the felled trees while they are still green. Then the bark could be stripped and processed whenever convenient.

WINTER FOOD OF GAME BIRDS

WEED seeds are turned into meat by game birds; they form the chief winter food of several species, according to studies by Philip S. Baumgras, of the Michigan Department of Conservation. Mr. Baumgras's report will be printed in full in the *Journal of Wildlife Management*.

That bane of hayfever sufferers, low ragweed, turns out to have some use after all. It yields the biggest supply of winter feed for the birds, as indicated not only by a study of pheasant crop contents, but by careful hand harvesting and weighing of ragweed seed from a number of typical Midwestern field environments. Wheat stubble fields were an especially rich source, yielding an average of 205 pounds an acre in October. Other weed seed serving as winter food for wildlife species include foxtail grass, lambsquarters, black bindweed, smartweed, barnyard grass, finger grass and pigweed.

Wild birds and small game animals are good gleaners of grain left in the field after harvest. In the fields studied by Mr. Baumgras there was an average of nearly seven bushels of corn left unpicked by the mechanical harvester. Most of this was salvaged by livestock; the remainder was used by wildlife. Pheasants especially like corn, though it is not always the best food for them. Squirrels go after it, too, especially when the crop of acorns and beechnuts is short.

Wheat fields cut with a tractor-drawn binder yielded nearly two and a half bushels of waste grain per acre, and oat fields a bushel more than that. This scattered grain was picked up mainly by starlings and blackbirds, but to some extent by pheasants and ducks.

ITEMS

HOPE for a raw-egg-white cure of cancer should not soar too high on the basis of New York research reported from Chicago. Future publications are sure to give the negative side of this line of attack. The method is being studied in several scientific institutions which will report their findings as soon as sufficient studies have been made to warrant drawing conclusions. The raw-egg-white treatment is based on the theory that, since a high content of the vitamin chemical, biotin, has been found in cancer tissues, treatment with raw egg white should be beneficial because raw egg white contains an antibiotin chemical, avidin. The raw egg white, according to this theory, would destroy the biotin believed by some to be necessary to the life of the cancer. Biotin, according to previously published reports, favors the development of one kind of liver cancer in rats. Its exact role in human cancer has not yet been determined. Efforts to reduce the amount of biotin in the human body by means of raw egg white are not without danger. A vitamin hunger disease, technically termed biotin deficiency, with symptoms strikingly like those of vitamin hunger diseases due to vitamin lack from poor diet, has been produced in humans by large doses of egg whites.

THE U. S. Department of Agriculture, which produced sheer cotton hose when silk grew scarce, is now experimenting with substitutes for sheer cotton. At the experimental hosiery mill at Beltsville, Md., government technicians are trying to make elastic, durable hose from medium-length fibers, now that most of the long-staple cotton is needed for parachute harnesses, airplane cloth and other war fabrics. Most of the cotton mesh or ribbed hose now being sold are made of fine two-ply yarn from long-staple fibers. They are also original government designs or adaptations of them. Present research aims to increase the strength and elasticity of single-ply yarn by means of high twist and chemical finishes. The results may not be so sheer, but they will be practical.

IN Crawford County, Ark., where spinach growing is a really big-time industry, some 13,000 acres were planted very early last fall, in hopes of getting an extra cutting early in the season. What happened instead was a terrific epidemic of a fungus disease, downy mildew, which took from a third to a half of the first cutting. According to Dr. Seth Barton Locke, of the Arkansas Agricultural Experiment Station, the too-early planting gave the fungus its chance. The epidemic died down by mid-December, but dead leaves around the bases of the plants were found to be carrying an abundance of spores, ready to start mischief again when the weather warms up.

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HEALTH EDUCATION IN A DEMOCRACY[1]

By Dr. C.-E. A. WINSLOW

PROFESSOR OF PUBLIC HEALTH, YALE SCHOOL OF MEDICINE

THE Health Education Institute is a remarkable institution and it is a great pleasure to watch its progress from year to year. I take a certain vicarious pride in it on account of the large part that my colleague, Professor Hiscock, has played in its development in the past. It is fascinating to see its scope widen and deepen. Particularly this year, apparently, your stress has been not so much on what may properly be called propaganda—although propaganda is important and desirable—but on community organization. Such a tendency toward community organization is a practical application of your basic maxim of education by doing. Education by committee is far more effective than education by poster or bulletin or cinema. The whole trend, the inherent drive of your educational ideas has brought about the realization that community action is the most powerful educational force; it's the thing that works. While I was in this field many years ago I felt very strongly that while bulletins and posters and meetings and so on were helpful they were like the torchlight processions of those days and the rallies that were held during a political campaign. Those things were after all only the trimmings. They didn't win the election. What won the election was the ward committee and the ward chairman working 365 days in the year. The kind of permanent health organization that has been developed in many communities is not only educationally sound in that it involves the activity of self-educated members but it is also the potent way to develop community action.

[1] This paper was presented before the Health Education Institute at the annual meeting of the American Public Health Association in St. Louis, October, 1942.

I was particularly proud this morning to note that four of the seven speakers were graduates from the Yale Department of Public Health. But Dr. Walker certainly didn't learn his pessimism there. He seemed to be dissatisfied with what he called a definition of health education. Health education, he said, is something that happens inside to change actions in a certain direction. You couldn't have a better definition than that. We don't know what lead is or copper or wood. Science doesn't know what anything is except by its actions. Lead is the thing that reacts in a certain way when you apply acid to it and which has a certain weight and so on which affects scales in a certain way. Dr. Walker's definition is a good scientific definition. Something happens inside; it doesn't matter what it is, but you measure it by its results. If it changes action in a certain direction it is successful health education. Here, as in all other fields of human thought and human activity, it's easier to think things out than to do them, and we mustn't fall into the danger of going back from a meeting like this and assuming that because very sound principles of community organization have been formulated they're necessarily going to be applied. Progressive educators very long ago formulated similar principles to those we've heard stated here for school education. They, too, agreed many years ago that education in schools should be something that was self-motivated, that should arise out of a conscious need of the students in the classroom, but I wonder how many schools of the country are actually operating just that way to-day; and the actual realization of this idea of motivation through conduct is still a long way ahead.

Only a week or two ago we had in our clinical case conferences for the medical students a session on tuberculosis and three cases were reported. In these clinical case conferences the students are supposed to have visited the home and come in contact with all the social agencies. They approach the case from the standpoint that somebody was sick and nobody ought to be sick. What was the matter? Who failed here? Now in one of those cases there was no failure. The machinery worked almost perfectly. In the other two cases, curiously enough (for what happened this year couldn't have happened ten or fifteen years ago), the medical and community machinery of the ordinary type worked about 100 per cent., too. There is nothing you could say that should have been done differently, except patient cooperation. It happened that the failure in two of the three cases was entirely due to the problem of internal emotional motivation; and of course we're not satisfied now to say merely that the patient was "uncooperative." The problem as it happened in two out of the three cases was a problem of health education in the sense of the development of the right kind of motivation. Two out of these three families were governed by motivations that were absolutely hostile to modern health and medical service.

Furthermore, I'd like to point out that this task of motivation is going to be rather more difficult in the future than it has been in the past. In general, health education has started with objectives that were quite obviously desirable for the individual. A person who is beginning to come down with tuberculosis ought to be about as easy to motivate toward getting well as anybody could be. As I say, in these two cases, this wasn't true, but still, it's a relatively easy problem. Furthermore, the concept that was prominent twenty years ago was the protection of one individual against contagion from another. And that after all is fairly simple motivation. Nobody wants the germ of tuberculosis to be introduced into his home. We began with fairly easy types of motivation and in the future I think we're coming more and more to deal with problems where the fundamental motivation is much more difficult. We can see without any question that the chief causes of death in the future will not be germ diseases and that the motive of protection against infection is not going to be a vital part of the picture. The chief causes of death are more and more going to lie in the individual and in his social environment, and our educational objectives will not be anything as simple and obvious as the concept of distributing tuberculosis germs by spitting on the sidewalk. Furthermore, as we see the public health movement, the future causes of death are in themselves very minor parts of the problem. Success of the public health movement in the future is not going to be measured by changes in the death rate. Our ideal is going to be health and not merely keeping out of the mortality records of the statistician. It's going to be that sort of thing which I never tire of quoting, the statement of William James that "merely to live, move, and breathe should be a delight." That's what we mean by health. And thus we can not be satisfied merely with alleviative medicine; we must not be satisfied even with merely preventive medicine.

We haven't got very much preventive medicine yet, but if we had, that isn't enough. After all, the term "preventive" is a negative thing. Something like *constructive medicine* is what we shall want in the future —medicine that will be actuated by the upbuilding of health and not merely by protection against specific diseases. And we already have something like that operating in the field of pediatrics. I don't think it's general in any other branch of medicine, but pediatric practice is coming to be something in the nature of constructive medicine. It is rather interesting though that even in pediatrics (I inquired about this a little

while ago) the text-books are still all written around diseases. There isn't even in pediatrics a text-book written about the health of the child in the first three months and the health of the child in the second year, and so on. They are all still under disease headings. But the practitioners have got ahead of the text-books, as very often happens. And if health is constructive, health must of course include mental and social as well as physical health. Now those things are less easy to realize and above all they haven't the compelling force of direct danger to one person from another. You remember that the first impulse in the development of the factory laws in Great Britain 140 years ago was the idea that disease was spreading among the apprentice laborers and would spread to the rest of the community.

Such a motive is not so obvious in the case of the health problems of the future. You can fairly easily get people to pay taxes for protection against epidemics, but it's going to be a good deal more difficult to obtain the kind of motivation that will justify financial sacrifices for housing and medical care and social security. The argument "am I my brother's keeper" is used by many who would deprecate any comparison of themselves to the one who first used that phrase. Yet no society is healthy when a third or a tenth of the nation lacks the essential decencies of normal life and the difficult task of the health educator in the future is to convince the public that this is true, that the existence of a substandard slum area is a menace to the city, not in the crude sense that smallpox is going to spread from it but in a sense that the social life, the communal life of the community, is going to be poisoned by these gross inequalities in social structure.

Our problem is even more grave, however. This conception of interactions, this conception of the fact that we all are parts one of another, has got to be realized on an international as well as on a national scale. Some people don't want to think about that. The McCormicks and the Pattersons who a year ago didn't want to prepare for war (and now just those same people don't want to prepare for peace) say, "Let's talk about nothing else but the immediate job of winning the war." They are again showing the same characteristic short-sightedness or possibly fundamental subconscious sympathy with the objectives of the enemy. We can't separate the war and the post-war problems in this case. Some wars have been such that you could set aside and put away social gains. They've been wars for territory or national prestige. This isn't that kind of a war. It's a war for an idea, a war for a way of life, and it's impossible to win a war of the gravity and seriousness of this one without "full cooperation" as Mr. Willkie so splendidly pointed out last night. Furthermore, if you could win it at the sacrifices of the fundamental welfare of the people of this or any other country you wouldn't have really won because that is, after all, what we are fighting for, a way of life, an opportunity for all people. That is the very issue that is at stake. People will agree to this very readily in theory, but I happened to hear two instances recently that interested me. One was a Rotary Convention in Toronto last spring at which a friend of mine spoke eloquently on the post-war world and one of the members came up to him afterwards and said "That was a splendid speech, perfectly magnificent, I agree with everything you said, but of course, remember this, there mustn't be any tinkering with the tariff." The other instance was a Labor Convention in New Jersey at which ideals of a new world order were widely applauded until the question was raised whether the post-war industrialization of China would not menace the standard of living of the American workingman.

I assume we're going to win the war, and we might as well assume that, because if we don't nothing matters anyhow. But assuming we're going to win it, our task is only half done. We must also win the peace; and that means building a new world in which all the people in all the nations have a fair chance to improve their social status. I think that England has learned her lesson and is in the mood to build such a world order. Russia and China are committed to it. The vital question of the post-war period is whether we in the United States are going to be ready as a people to meet this challenge or whether we are going to do what we did in 1920 and give up in peace all that we had won in war. There is a very peculiar challenge to the United States to perceive the importance of world health and recognize its own responsibilities toward world health in a broad sense of the term. As you see, that challenge goes to the very heart of our problem of education. And one thing that has been emphasized in these discussions this morning is what I like to visualize as marking the difference between education and training. All through schools and colleges and universities you must have both training and education. By training I mean something that develops an automatic response to external stimuli. We train a dog to go to heel. We train a child to speak English. We train a medical student to recognize the eruption of measles. We train an engineer to apply a mathematical formula. Those are all valuable forms of training, but they are not education. The word "education" means to lead out, it involves a widening of vision and a deepening of thought. It's an imaginative, a creative process.

Education is not possible for a dog in this sense. Education is possible for a man, outside of Nazi Germany and Japan where nothing but training is permitted. It is very wholesome often to begin with training and develop into education. You remember that the great centers of philosophy in Greece, the academy of Plato and the Lyceum of Aristotle, were both gymnasia. They were originally places for physical exercise which became centers of the greatest schools of philosophy in the world. The medieval universities were primarily technological. They were intended to train men for the priesthood. The modern university is, and in a large measure ought to be, based largely on technology; but these institutions fail terribly of their purposes if they remain training institutions, if they remain merely technological. It is an interesting thing to realize—perhaps it is one of the lessons that the war teaches—that technology instead of making fundamental education in the old sense unnecessary makes it enormously more necessary. The greater the mastery of man over the material world, the more difficult become the relations between men as men, and the more vital becomes real education which doesn't just train men to respond automatically to stimuli but trains them to understand and to want sound relationships, the most precious fruit of which is in cooperative action. No nation that does not have effective cooperation can survive. Pure individualism is only possible to the pioneer in the wilderness. So that the problem is not whether we shall have cooperative action or not, but what kind of cooperative action we have. And there are two ways, these two same old ways, of getting it, training and education. Training is, of course, the easiest way.

Did any of you read (and I hope you have, it's one of the most significant of recent war books) Smith's "Last Train from Berlin"? Among the disheartening things in it are his pictures of the tremendous power and efficiency with which all initiative, all imagination, all sympathy, all human quality is trained out of the victims of the Nazi régime, and the way they are molded into a rigid, utterly heartless, terribly powerful machine. Training is relatively easy, but after all the trouble is that it's inadequate to meet conditions in this changing universe. The moth which flies toward the sun also flies into a flame, the merely trained person, when conditions are altered, when conditions become complex, if he has no education, no orientation, is as likely as not to march off a cliff into the sea. We are witnessing to-day a world struggle between, on the one hand, peoples who are fully trained and on the other hand our own peoples who are half educated. And that is our problem in the Solomon Islands now. We're suffering because we are half-educated people meeting a very fully trained people and our task is, of course, to complete that education in a sense of the understanding of relationships and of the need and possibilities of cooperative action by democratic consent. It would be easy to produce common action by training, but in this country we are trying a more difficult and a nobler experiment. We are seeking to accomplish the aims of national planning by common consent and not by compulsion, to create a new social economy within the framework of a democratic order and without loss of the essential values of the older liberalism. Our success is still problematic. Whether the obstructive forces of ignorance and selfishness can be overcome without Naziism or Fascism is still on the knees of the gods, but on the success or failure of this experiment may depend the course of civilization for a century to come. The problem to-day is: "Can we on our side achieve cooperative action by common consent? Can we do it in the war? Can we do it in the peace that follows?"

The answer, the only possible hopeful answer, lies in the fullness of education, in the development of education to the point that you have visualized in your particular field, but education which comprehends the entire picture of man's life and his relations to the international environment, the world in which he lives. You can truly feel you are doing your part, and you, with leaders in other fields, must go on with the type of education that gives a sense of the fullness of personal health and the fullness of communal cooperative living, not just as an idea, a phrase, but actually as a compelling force in the governance of the motivation of mankind.

NICHOLAS COPERNICUS

THE FATHER OF MODERN ASTRONOMY 1543–1943

By STEPHEN P. MIZWA

SECRETARY OF THE KOSCIUSZKO FOUNDATION AND OF THE COPERNICAN QUADRICENTENNIAL NATIONAL COMMITTEE

ON May 24, 1943, the civilized world—or whatever remains of it—will commemorate the four hundredth anniversary of the death of Nicholas Copernicus, the great Polish astronomer, whose immortal work "De Revolutionibus Orbium Coelestium" revolutionized man's outlook upon the universe.

At the initiative of the Kosciuszko Foundation, which, since 1925, has endeavored to promote cultural relationships between Poland and America, one of the greatest scientific tributes in history is being planned throughout the United States for May 24th, when hundreds of American universities, colleges, private schools and technical institutions will join the Foundation in paying tribute to one of the truly great geniuses of the world. Most of the Canadian colleges and universities and the Royal Astronomical Society of Canada are making similar plans. Appropriately enough in Latin America the initiative was taken by the oldest university on the American continent, that of San Marco in Lima, Peru, which was established in 1551. The New York Public Library, the Library of Yale University and many other scientific and public libraries all over the country are making plans to place in special exhibitions old editions of Copernicus's works and many rare and interesting items pertaining to the great astronomer. These Copernicana exhibition plans have already revealed that there are several copies in the United States, and at least one in Canada, of the first (1543) edition of "De Revolutionibus," the first copy of which its creator beheld on his deathbed on the very last day of his mortal journey. Several of our planetaria are planning special programs for the month of May, demonstrating and explaining the pre-Copernican and the Copernican systems of the universe. At Carnegie Hall in New York, on May 24th, there will be held a meeting in tribute to Copernicus under the auspices of the Copernican Quadricentennial National Committee, headed by Professor Harlow Shapley of Harvard as chairman, whose membership will include distinguished scientists, representatives of the leading learned societies and research institutions, higher institutions of learning and representative Americans.

"Why stop to pay tributes to anybody in times like these, when we are waging a war of the survival?" "What did Copernicus do?" "Who was Copernicus, anyway?" These questions are not intended as an insult to the intelligence of the readers of this journal. They are simply pegs on which to hang one's thoughts. And they are not impertinent, either. They have been raised even by intelligent people. Within one week the present writer met three college graduates whose liberal education was deficient at least in one respect. One frankly admitted he never heard of Copernicus. Another thought that he (*i.e.*, Copernicus and not the college graduate) had something to do with the moon. And the third was sure that judging by the sound of the name, Copernicus must have certainly been a Greek philosopher.

At any rate, who was he and what did he do to deserve such a national tribute as is being planned even in times like these? The answer implies deeper significance than mere recognition of a great scientific genius. It is not alone the transcendent mind of Copernicus the scientist that stirs one's imagination; it is also his heart, the sum total of his interests and his manner of doing things that commend him to our attention, even in times of turmoil like these. He also lived in an age of mental revolution, of spiritual conflicts and of political turmoil. He took active part in the political turmoil, withstood the pressure of spiritual conflicts, and out of the mental revolution he brought us a new conception of the place of this homely planet of ours in the celestial scheme of things. Like the mythical Prometheus, who stole the fire from selfish pagan gods by holding a rod close to the sun, Copernicus snatched a big chunk of truth—to use the college vernacular—from the bosom of stubborn nature which zealously guards her secrets from inquisitive man.

As astronomer and mathematician, for he is generally known as that, he did have "something to do with the moon." But he did more than that. Whether speaking jovially or contemptuously, Martin Luther referred to Copernicus as that "fool who would overturn the whole science of astronomy." That is just exactly what he did. He rebuilt the whole science of astronomy on an inverted order; he bade the sun to stand still and set the earth in motion, set it on its eternal course around the sun. Of course, like Monsieur Jardin who spoke prose all his life without knowing it, the earth was always coursing around the sun; but for centuries laymen and learned men spoke poetry when they maintained the geocentric theory that the earth—whether flat or spherical—was the center of the universe and it was the sun that moved around. By reversing the process Copernicus created the so-called heliocentric (with the sun as the center) law of planetary motions.

This is easier said than done. It took more than daring intellectual courage and fantastic imagination to essay the heights of heavens. It took tact and spiritual courage to maintain his views not as a hypothesis, useful for astronomical calculations though not necessarily true, as some of his friends advised him to do, but as an established scientific truth. By his tenacity he loosened the grip of the dead hand of authority—authority of accumulated scientific and church dogmas, authority of all his learned predecessors and contemporaries, authority of the sense of vision, authority of the stubborn pride of man who, in the geocentric system, saw himself as ruler over the entire center of the universe. According to the Copernican conception, man became just a speck of dust clinging tenaciously for his dear life, on the surface of the earth as it majestically swings around

the sun. Yes, Copernicus showed tact when he dedicated his great treatise to Pope Paul III and pleaded that he also be given the freedom of scientific inquiry—to follow the truth wherever it may lead. In paying tribute to Copernicus of four hundred years ago, the scientific word of to-day reaffirms its own faith in the dignity of free scientific inquiry, which has practically always been the transatlantic American charter. Why do we stop to honor Copernicus to-day? Because his words of courage and his message to the contemporary scientific world are as modern as to-morrow.

But Copernicus was more than a scientist. He was a churchman, a painter and a poet, a physician, an economist, a statesman and a soldier. He was not fully ordained a priest as some people erroneously believe; he had only minor orders. In the church hierarchy he was a canon, charged with the duty of administering church property in the duchy-bishopric of Varmia, the then Polish province but after the first partition of Poland in 1772 incorporated in East Prussia. In his varied career he painted his own portrait. The original, unfortunately, has not been preserved. We know it only from the copy that was produced in the sixteenth century and later reproduced on the astronomical clock tower of the Cathedral of Strasbourg. His first published book, in 1509, revealed him as a poet and incipient man of letters. It was a translation of the epistles of a secondary Greek writer, Theophylact. As a physician he would have made a much greater reputation than that of a poet if astronomy had not absorbed his interest in mature years. Such reputation concerning his medical profession as has come down to us has been clothed more in the garb of philanthropy rather than that of professional shrewdness. Although not infrequently called to the bedside of the influential and the affluent, including ruling princes, in his capacity as physician he is best known by his gratuitous ministrations to the poor. He was also an economist. Called by the Polish king, Sigismund I, to help reform the currency system in the northwestern Polish provinces, Copernicus formulated the monetary law of "good and bad money," which through historical error was ascribed to Gresham and the principle became known as Gresham's Law. Copernicus formulated this law at least 22 years before Sir Thomas Gresham.

And, among his multifarious activities, Copernicus was a statesman and once even a soldier. All his life he was an inveterate enemy of the Knights of the Teutonic Order, whose possessions—East Prussia, then Fief of Poland—surrounded the province of Varmia on three sides. This order, then headed by Albert of Hohenzollern, was the direct predecessor of the present widely heralded Teutonic New Order of Europe, introduced or revived by a formerly much-heard-of Austrian corporal. The former Teutonic Order knew all the tricks of fifth-column work; it tried to create dissensions and foment disorders in the neighboring Polish provinces. Several letters of complaint to the king of Poland, drawn up by the pen of Copernicus on behalf of the bishopric of Varmia, have come down to us. Without mincing words, Copernicus called them "thieves and robbers." While on his business visit to the city of Olsztyn (Allenstein), which was surrounded by armed forces of the Teutonic Order, Copernicus assumed the function of commander in chief.

And now, while the descendants of the Knights of the Teutonic Order have closed the University of Krakow, the alma mater of Copernicus, have imprisoned most of its professors and murdered others, and are trying to destroy all visible monuments of Polish culture, a tribute to Copernicus will give the still surviving Polish scholars and the gallant Polish nation courage to endure.

OBITUARY

HARRY HAMILTON LAUGHLIN

DR. HARRY HAMILTON LAUGHLIN, son of George Hamilton Laughlin, one-time president of Hiram College, was born in Oskaloosa, Iowa, in 1880. He was graduated Sc.D. from Princeton and was given an honorary M.D. degree by the University of Heidelberg. At the age of twenty years he was principal of the Kirksville (Mo.) high school and later teacher of agriculture at the North Missouri State Normal School. At the foundation of the Eugenics Record Office by Mrs. E. H. Harriman in 1910 he was put in immediate charge of its administration, until in 1921 it was incorporated in the Department of Genetics, with him as assistant director.

He early showed a special interest in the application of the principles of human heredity to human affairs. As an expert for the Committee on Immigration and Naturalization of the House of Representatives he played an important part in securing the quota system of limited immigration into the United States from the Old World; and in 1923 he was sent by the Department of Labor to observe and advise concerning the operations of immigration selection in Europe. He was appointed a member of the Permanent Emigration Committee of the International Labor Office of the League of Nations. Later he worked especially on the topic of sterilization as a eugenical measure and published the stand-

ard book on the subject. His later years were devoted to a study of the inheritance of racing capacity in thoroughbreds—a trait in whose inheritance so many factors are involved that Laughlin was led to resort to mass analysis.

Laughlin was highly developed socially and made life-long friends through his interest in the people with whom he was associated.

At the outbreak of World War I he became captain of the local home defense reserve and gave military training of a quality that was acclaimed by army officers. He and Mrs. Laughlin were fond of entertaining at their house, and all the children of the neighborhood gathered there at Christmas time to meet him in the role of Santa Claus.

As an administrator he had unusual gifts and he was able to utilize effectively the work of a considerable number of assistants toward the accumulation and analysis of a very complicated mass of data. His thinking and writing were characterized by great perspicacity. His was a legal mind, and some of his drafts of bills for legislation were incorporated almost without change in the acts of state legislators. He was related to President James Madison.

Some of Laughlin's conclusions and their applications in legislation were opposed by those committed to a different social philosophy, founded on a less thorough analysis of facts. One can not but feel that a generation or two hence Laughlin's work, in helping bring about restricted immigration and thus the preservation of our country from the clash of opposing ideals and instincts found in the more diverse racial or geographical groups, will be the more widely appreciated as our population tends toward greater homogeneity.

CHAS. B. DAVENPORT

ROBERT GREENLEAF LEAVITT
(1865–1942)

DR. ROBERT GREENLEAF LEAVITT, well-known biologist and writer, died at North Parsonsfield, Maine, on October 2, 1942.

Dr. Leavitt was born at North Parsonsfield on September 28, 1865. He graduated from Worcester Academy in 1884 and from Harvard University in 1889. He was granted an A.M. from Harvard in 1898 and a Ph.D. in 1904.

He was science master at De Veaux College, 1890–91; head master at Concord Home School, Concord, Mass., 1891–93; instructor in physics at Williston Seminary, Easthampton, Mass., 1893–97; investigator at Ames Botanical Laboratory, North Easton, Mass., 1899–1908; and head of the department of biology at the New Jersey State Normal School (now the New Jersey State Teachers College) at Trenton from September, 1908, until he retired in June, 1928. He was instructor in botany at the Summer School of Harvard University, 1903–07; and after his retirement continued his researches and his writing and maintained an active interest in everything connected with his field.

He was the author of "Outlines of Botany," which after forty years' use as a textbook is still regarded as an authority, "The Forest Trees of New England," a very popular tree book written for the Arnold Arboretum of Harvard University, numerous articles in general and educational magazines, and numerous technical papers and bulletins. He was a fellow of the American Association for the Advancement of Science.

Dr. Leavitt possessed an unforgettable personality and a homely, original contagious wit which made him a delightful companion and in great demand as an after-dinner speaker and toastmaster. His genial and lovable nature won and held for him a multitude of friends.

His widow, two sons and a daughter survive him.

ROSCOE L. WEST

NEW JERSEY STATE TEACHERS COLLEGE,
TRENTON

DEATHS AND MEMORIALS

DR. WILLIAM S. BAYLEY, who retired in 1931 from the professorship of geology at the University of Illinois, where he was head of the department, died on February 14 at the age of eighty-one years.

DR. ALBERT B. PECK, professor of mineralogy at the University of Michigan, a member of the faculty since 1914, died on February 15 at the age of fifty years.

DR. FRANKLIN P. JOHNSON, formerly professor of anatomy at the University of Missouri and since 1929 assistant professor of urology at the Medical School of the University of Oregon, died on February 12 at the age of fifty-five years.

MARTIN HALVOR KNUTSEN, professor of bacteriology at the Pennsylvania State College for the past twenty-three years, died on February 6 at the age of fifty-five years.

Nature reports the death of Dr. J. F. Craig, professor of veterinary pathology at the University of Liverpool; of Dr. Cyril Crossland, the first director of the Marine Biological Station at Ghardaqa, Gulf of Suez, on January 7, aged sixty-four years; of Lord Hirst, honorary member of the British Institution of Electrical Engineers, chairman of the General Electric Company, on January 23, aged seventy-nine years; of Dr. Alexander Russell, F.R.S., formerly principal of Faraday House, London, on January 14, aged eighty-one years; of Professor J. Strohl, professor

of zoology and comparative anatomy at the University of Zurich, and of Professor A. K. Cajander, formerly professor of forestry in the University of Helsinki and director-general of the State Board of Forestry in Finland, Prime Minister of Finland from 1922 to 1924 and from 1938 to 1939, on January 21, aged sixty-three years.

THE New York Academy of Medicine, in cooperation with the State Department of Health, the City Department of Health and six of the leading voluntary organizations in the fields of maternal welfare and child health, celebrated on February 19 the one-hundredth anniversary of the publication by Oliver Wendell Holmes of his paper entitled "The Contagiousness of Puerperal Fever." In connection with this celebration a full day's program of conferences and discussions was held. The principal speakers at the evening meeting were Dr. Reginald Fitz, of Boston, and Dr. Benjamin P. Watson, director of the Sloane Hospital for Women, New York.

Nature reports that to commemorate the birth, on March 3, 1843, of the distinguished metallurgist, Sir William Chandler Roberts-Austen, the British Institution of Mechanical Engineers, the Iron and Steel Institute and the Institute of Metals have arranged a lecture on his life and work, to be given by Dr. S. W. Smith.

THE section of historical and cultural medicine of the New York Academy of Medicine sponsored a Vesalius Celebration on January 13 to honor the quadricentenary of the publication of "De Humani Corporis Fabrica (1543)." The speakers were Drs. Arturo Castiglioni, Baltimore, on "Andreas Vesalius, Professor in the Medical School in Padua" and Henry E. Sigerist, of the Johns Hopkins University, on "The Position of Vesalius in the History of Medicine." There was an exhibit of books of Vesalius from the library of the academy.

THE *Journal* of the American Medical Association states that the chancellor and president of the University of Toronto and members of the university staff recently accompanied Lady Banting to Mount Pleasant Cemetery to place a wreath on Sir Frederick's tomb. The occasion marked the fifty-first birthday anniversary of Sir Frederick, codiscoverer of insulin.

SCIENTIFIC EVENTS

BRITISH COLONIAL PRODUCTS RESEARCH

THE Colonial Office has announced the appointment of a Colonial Products Research Council, with Lord Hankey as chairman. *The Times,* London, states that one of the functions of the Colonial Research Committee, which was set up last year under the chairmanship of Lord Hailey, was to review the whole field of research as it affects the Colonial Empire and to make recommendations for filling gaps in the existing organization for conducting such research. The new council fills one such gap.

Unlike the Colonial Research Committee, the council will be an executive body. It will consider what colonial raw materials may be made of value for the manufacture of intermediate and other products required by industry and it will initiate and supervise researches, both pure and applied, on such products, and generally consider how by the application of research greater use can be made of them.

In framing its program the council will have as its principal objective the promotion of the welfare and prosperity of Colonial peoples, and will endeavor also to increase the colonial contribution to the welfare and prosperity of the British Empire and of the world as a whole.

In carrying out its program, the council will cooperate with existing institutes, such as the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council, to the greatest possible extent, and will "farm out" work to these and other bodies by arrangement; it will set up facilities of its own only for work which can not be done by other means. It will be appreciated of course that so long as the war continues, the investigations which the council will be able to undertake will necessarily be limited.

The council is composed as follows: Eric Barnard, Department of Scientific and Industrial Research; G. L. M. Clauson, Colonial Office; Aneurin Davies; Dr. J. J. Fox, Government Chemist; Professor W. N. Haworth; Sir Harry Lindsay, director of the Imperial Institute; Sir Edward Mellanby, Medical Research Council; Professor Sir Robert Robinson; G. W. Thomson, and Dr. W. W. C. Topley, Agricultural Research Council. Professor J. L. Simonsen, lately of the University College of North Wales, has been appointed director of research.

Certain members of the council are also members of the Colonial Research Committee and the council will work in close touch with that body. It will be financed out of the provision for research in the Colonial Development and Welfare Act.

BIOLOGICAL ABSTRACTS

THE wide field which *Biological Abstracts* covers and the promptness with which its abstracts appear

have made it an indispensable adjunct to every biological department. Individual workers are especially concerned with only a part of the whole field, however, and for them the possibility of subscribing to one or more sections has been a great advantage. For most of us, even a section is rather large, and some means of collecting references to papers in a narrower field is essential. This is usually accomplished by a card file of some sort. For a number of years the present writer has been clipping from two of the sections the abstracts in his own field of interest, and pasting them in the upper left corner of 5 x 8 cards. This provides an easily prepared and legible means of filing and a considerable space for further notes in each paper. Doubtless other workers are using the journal in a similar way. Often, of course, two abstracts which are desired will occur on opposite sides of the same sheet, making it impossible to clip both of them and requiring the copying of one. It is therefore fortunate that *Biological Abstracts* is now offering for workers who use the sections in this way *two* copies of any section at a much reduced rate, which will make it possible to clip abstracts regardless of their location. Many biologists will doubtless take advantage of this offer of a convenient and relatively cheap means of building their individual bibliographical files.

EDMUND W. SINNOTT

YALE UNIVERSITY

THE COMMITTEE ON FOOD COMPOSITION OF THE NATIONAL RESEARCH COUNCIL

AT the request of the Quartermaster General of the United States Army, the Food and Nutrition Board of the National Research Council has organized a Committee on Food Composition, Dr. C. A. Elvehjem, *Chairman,* to collect, coordinate and appraise food composition data. The committee is to act as the repository and point of dissemination for authentic data on all foods being used or considered for use by all branches of the Military Services.

Proximate and mineral composition as well as analyses for vitamins A, C, thiamine, riboflavin and niacin are required as a basis for nutritional evaluation of these foods. Data on new products, processed foods and dehydrated meats, fruits and vegetables especially are needed.

The committee has already enlisted the cooperation of Federal and State laboratories throughout the country. However, it is also aware that a great wealth of food composition data has been accumulated in the course of research and routine analyses by industrial laboratories.

It is the purpose of this communication to appeal to these laboratories of the food industries to make their data active in the war effort. The committee assures that data received for this purpose will be handled with such reservations as should be exercised in the official utilization of this information by the Armed Services only.

Please address Dr. Paul L. Pavcek, Secretary, Committee on Food Composition, National Research Council, 2101 Constitution Avenue, Washington, D. C.

COMMITTEE OF THE NATIONAL RESEARCH COUNCIL ON THE MAINTENANCE OF PURE GENETIC STRAINS

DURING the past year, the Committee on the Maintenance of Pure Genetic Strains, National Research Council, has held two meetings for the purpose of preparing a list of the more important mutant strains and inbred lines. Information gathered thus far can be summarized as follows.

"Drosophila Information Service," prepared by Dr. M. Demerec and issued by the Carnegie Institution of Washington at Cold Spring Harbor, Long Island, New York, lists 60 species, 2,000 different stocks and 93 laboratories throughout the world where stocks are maintained.

Mouse Genetic News, edited by Dr. George D. Snell and issued by the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Maine, lists 70 inbred strains of mice and 40 laboratories in the United States where stocks are maintained.

Dr. C. C. Little, the Roscoe B. Jackson Memorial Laboratory, has listed a few mutant and inbred strains of guinea-pigs, rabbits and rats, together with institutions in which they are being maintained.

Dr. Walter Landauer, Storrs Agricultural Experiment Station, the University of Connecticut, has prepared a list of poultry and pigeons which includes 47 or more inbred strains of fowl, 5 of turkeys, 16 inbred or mutant strains of pigeons and 17 institutions in the United States where stocks are maintained.

Dr. Myron Gordon, American Museum of Natural History, New York City, is assembling a list of cold-blooded vertebrates which includes 7 species of Xiphophorini with 28 characters and several species and genera of fish maintained in at least 10 institutions.

Dr. P. W. Whiting, Zoological Laboratory, University of Pennsylvania, is preparing a list of insects other than Drosophila which include Orthoptera, Lepidoptera, 3 species of Diptera with mutant types, *Apis mellifica* with mutant types, *Habrobracon juglandis* with mutant types, and 6 institutions in which one or more stocks are maintained.

L. T. WEBSTER,
Chairman

ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

THE annual meeting and dinner of the Council of the Union of American Biological Societies was held at the Hotel Normandie, Philadelphia, on January 17.

The business considered included a report of the "Committee on the Teaching of Biology" by its chairman, Dr. Oscar Riddle; a report on the activities of the "Cooperative Committee on Science Teaching" by the union's representatives, Dr. Oscar Riddle and Dr. W. F. Loehwing; a report on *Biological Abstracts* by its editor-in-chief, Dr. John Flynn.

It was decided that one of the major items on the agenda of the union for the immediate future would be the development of a program to establish closer relationships between the biologists of Latin America and those of the United States.

The following officers were elected to serve for the year 1943:

President, Dr. E. G. Butler, Princeton University.

Secretary, Dr. F. A. Brown, Jr., Northwestern University.

Treasurer, Dr. D. H. Wenrich, University of Pennsylvania.

Members of the Executive Committee, Dr. B. M. Duggar, University of Wisconsin; Colonel A. P. Hitchens, University of Pennsylvania, and Dr. G. W. Hunter, III, Wesleyan University.

FRANK A. BROWN, JR.,
Secretary

THE WASHINGTON ACADEMY OF SCIENCES

OFFICERS of the Washington Academy of Sciences have been elected as follows:

President, Leland W. Parr.

Secretary, F. G. Brickwedde.

Treasurer, Howard S. Rappleye.

Vice-Presidents representing the Affiliated Societies:

Philosophical Society of Washington, Raymond J. Seeger.

Anthropological Society of Washington, Frank M. Setzler.

Biological Society of Washington, Harry B. Humphrey.

Chemical Society of Washington, Herbert L. Haller.

Entomological Society of Washington, Austin H. Clark.

National Geographic Society, Alexander Wetmore.

Geological Society of Washington, Clarence S. Ross.

Medical Society of the District of Columbia, Frederick O. Coe.

Columbia Historical Society, Allen C. Clark.

Botanical Society of Washington, Charlotte Elliott.

Washington Section of the Society of American Foresters, William A. Dayton.

Washington Society of Engineers, Frank B. Scheetz.

Washington Section of the American Institute of Electrical Engineers, Francis B. Silsbee.

Washington Section of the American Society of Mechanical Engineers, Walter Ramberg.

Helminthological Society of Washington, Emmett W. Price.

Washington Branch of the Society of American Bacteriologists, Ralph P. Tittsler.

Washington Post of the Society of American Military Engineers, Captain C. L. Garner.

Washington Section of the Institute of Radio Engineers, Harry Diamond.

Washington Section of the American Society of Civil Engineers, Owen B. French.

Elected members of the Board of Managers: John E. Graf and Frederick D. Rossini.

SCIENTIFIC NOTES AND NEWS

THE 1943 Washington Award, administered by the Western Society of Engineers, has been conferred on Andrey A. Potter, dean of engineering at Purdue University and chairman of the National Advisory Committee on Engineering and War Training, in recognition of "distinguished leadership in engineering education and research and patriotic service in mobilizing technical knowledge for victory in war and peace." Herbert Hoover received the first award in 1919. Other recipients include Arthur N. Talbot, Orville Wright, Michael I. Pupin, Charles F. Kettering, Frank B. Jewett and Ralph Budd.

THE 1942 Lamme Medal of the American Institute of Electrical Engineers has been awarded to Dr. Joseph Slepian, associate director of research, Westinghouse Electric and Manufacturing Company, East Pittsburgh, "for his contributions to the development of circuit interrupting and current rectifying apparatus." The medal and certificate will be presented to him at the national technical meeting of the institute, which is to be held in Cleveland, Ohio, from June 21 to 25.

THE Joseph A. Capps Prize for medical research of the Institute of Medicine of Chicago, founded by Dr. and Mrs. Edwin R. LeCount, has been awarded for 1942 to Dr. Mary E. Martin, Northwestern University Medical School (1941), for her investigation on "The Distribution of Nerves in the Adult Human Myometrium."

Nature reports that the Clough Memorial Medal of the Edinburgh Geological Society for the years 1941–1942 has been presented to James L. Begg, of Mount Vernon, Glasgow, for his contributions to Scottish paleontology. He has worked for many

years on the Ordovician rocks of southern Scotland and has discovered more than a hundred new species of trilobites, molluscs, brachiopods and other organisms, many of which belong to new genera. Mr. Begg, who is a past president of the Geological Society of Glasgow, has also served as its honorary treasurer for the past twenty-five years.

THE James Alfred Ewing Medal for 1942, on the joint recommendation of the presidents of the Royal Society and the British Institution of Civil Engineers, has been awarded to Dr. R. E. Stradling. The medal is awarded annually in recognition of specially meritorious research in the science of engineering.

THE Worcester Polytechnic Institute at commencement on February 11 conferred the degree of doctor of science on Dr. A. Wilmer Duff, professor emeritus of physics. Dr. Duff was presented by his successor, Dr. Masius, now head of the department.

THE following have been elected officers of the American Society for X-Ray and Electron Diffraction for the year 1943: *President,* Professor M. J. Buerger, the Massachusetts Institute of Technology; *Vice-president* and *President-elect,* Dr. L. H. Germer, Bell Telephone Laboratories, Murray Hill, N. J.; *Secretary-Treasurer,* Dr. George Tunell, Geophysical Laboratory, Washington, D. C.

OFFICERS of the American Society of Plant Taxonomists have been elected as follows: *President,* Dr. S. F. Blake; *Secretary and Treasurer,* Dr. N. C. Fassett; *Chairman of the Council,* Dr. E. E. Sherff.

THE Eastern Missouri Branch of the Society of American Bacteriologists has elected the following officers for the year 1943: *President,* Dr. Jane Burn Hershey, the Public Health Laboratories of the City of St. Louis; *Vice-president,* Dr. John B. Rehm, Research Laboratories, the Anheuser-Busch Company, and *Secretary-Treasurer,* Dr. Fred W. Gallagher, department of bacteriology, St. Louis University School of Medicine.

PHILIP GOLDSMITH, formerly sanitary engineer in the Department of Public Works of New York City, has been appointed acting director of the sanitary engineering research laboratory of the College of Engineering of New York University. He takes the place of Dr. Rolf Eliassen, who is on leave of absence as a captain in the United States Army.

DR. ROLLO C. BAKER, secretary of the College of Medicine of the Ohio State University since 1934, has been named acting dean of the college and acting director of the University Hospital. Dr. Baker was temporarily appointed to fill the position made vacant on January 15 by the death of Dr. Leslie L. Bigelow, Columbus. Dr. Bigelow had also been serving under a temporary appointment, while Dr. Hardy A. Kemp, Columbus, was absent on military service.

DR. FORREST W. QUACKENBUSH, of the department of biochemistry of the University of Wisconsin, has been appointed head of the department of agricultural chemistry of Purdue University. He takes the place of Dr. H. R. Kraybill and will be in charge of agriculture and research in the Agricultural Experiment Station. He will also be state chemist in charge of feed, seed, fertilizer and plant inoculant control for the State of Indiana.

DR. RICHARD M. EAKIN has been appointed chairman of the department of zoology of the University of California at Berkeley. He succeeds the late Professor J. Frank Daniel.

DR. JAMES A. DAWSON, associate professor of biology at the College of the City of New York, has been promoted to a professorship.

DR. MARIA J. A. VAN DER LUGT has been appointed assistant professor of psychology at the University of Vermont. She takes the place of Professor R. M. Collier, now a first lieutenant in the United States Army.

DR. FRANK A. CALDERONE, of the department of preventive medicine at New York University Medical School, has been made deputy health commissioner of New York City to succeed Dr. George T. Palmer, who has resigned.

DR. H. E. WOOD, professor of biology at the University of Newark and research associate in fossil mammals at the American Museum of Natural History, is now first lieutenant assigned to the Army Air Force.

CLIFFORD COOK FURNAS, associate professor of chemical engineering at Yale University, has been appointed director of research for the Airplane Division of Curtiss-Wright Corporation.

PHILIP N. YOUTZ, formerly director of the Brooklyn Museum and director of the Pacific House at the Golden Gate International Exposition, has been made chief engineer, Consumer Products Branch, Office of Production Research and Development of the War Production Board, Washington.

DR. A. DOROTHY BERGNER, of the department of genetics of the Carnegie Institution of Washington at Cold Spring Harbor, N. Y., has become associated with the Guayule Research Project of the Bureau of Plant Industry at Salinas, Calif.

W. A. PATTERSON, president of United Air Lines, has been elected to membership on the advisory board of the Institute of Aeronautical Sciences, Inc.

NORMAN NEAL, of the departments of agronomy

and genetics of the University of Wisconsin, with the approval of the Office of the Coordinator of Inter-American Affairs, has been invited by the Uruguayan Government to visit Uruguay to investigate opportunities for improving its maize and corn production.

COLONEL RICHARD P. STRONG, M.C., Army of the United States, director of tropical medicine in the Army Medical School, Washington, D. C., delivered on January 26 two lectures at the Harvard Medical School. His subjects were "The Importance of Tropical Infectious Diseases in the Present War" and "Diagnosis and Prevention of Plague and Cholera." On February 3, he delivered the Smith-Reed-Russell Lecture at George Washington Medical School on "Problems Regarding Malaria, Typhus Fever, Dysentery and Tropical Parasitic Infections in the War Areas."

AT the annual meeting in Chicago of the Heart Association on February 25, Dr. Arno B. Luckhardt, professor of physiology at the School of Medicine of the University of Chicago, was the guest speaker. He spoke on "Highlights and Shadows in the Discovery of General Anesthesia."

IT is reported in *Nature* that the Association of Polish Technicians in Great Britain held on January 17 a special tercentenary celebration of Isaac Newton, under the chairmanship of Professor Max Born, of the Mathematical Institute of the University of Edinburgh. Addresses were delivered by Professor E. T. Whittaker and Dr. S. Neumark, formerly dozent in aeronautics in the University of Warsaw and now a flight lieutenant in the Polish Air Force. He was introduced by Major Chodacki, formerly high commissioner for Danzig.

PROFESSOR R. T. CLAUSEN writes: "The botanical letters and papers of the late Professor Karl M. Wiegand (see SCIENCE, 95: 449–450, 1942), formerly head of the department of botany at Cornell University, have been deposited in the Cornell University Library at Ithaca, N. Y. These papers and letters are available for consultation by qualified scholars. Copies of particular items will be prepared upon the request of other institutions to the extent permitted by the facilities and time of the library's personnel."

THE American Association of Dental Schools will hold its twentieth annual meeting at the Drake Hotel, Chicago, on March 15, 16 and 17.

THE third program meeting of the New York Bacteriologists' War Research Projects Group will be held on the evening of March 3 at the College of Physicians and Surgeons, New York. Dr. M. L. Isaacs, of Yeshiva College; Dr. Selman A. Waksman, of the New Jersey Agricultural Experiment Station; Dr. Orville Wyss, of Wallace and Tiernan Products, Inc., and Dr. Geoffrey W. Rake, of the Squibb Institute for Medical Research, will participate in a discussion on "War Problems of Disinfection and Antisepsis." As in previous meetings, general discussion from the floor following the presentations will aim to formulate research projects to be undertaken by members of the group.

A SYMPOSIUM on the utility of lattice designs for field experiments undertaken as part of a plant-breeding program was the subject of a joint meeting of the Biometrics Section of the American Statistical Association and the American Society of Agronomy held in St. Louis on November 11 under the chairmanship of H. M. Tysdal. The program included an outline of the general properties of the designs by W. G. Cochran, a presentation of the methods of computation by F. R. Immer, and discussions of the conditions under which lattice designs should be used by G. W. Snedecor and S. C. Salmon. Reports on experience under practical conditions were contributed by seven agronomists—E. G. Heyne, I. J. Johnson, C. A. Lamb, W. M. Meyers, J. A. Rigney, J. H. Torrie and E. J. Wellhausen—and by members of the audience. Corn, wheat, oats, soybeans, clover and Kentucky bluegrass were crops with which these designs had been used.

THE *Bulletin* of the Institute of International Education writes: "Beginning on February 1, a six months' course in meteorology was initiated at Medellín, Colombia, by the United States Weather Bureau for students from all the American republics. Upon the completion of the course, it is planned to bring a number of the honor students to the United States for more extensive training in the following universities: the Massachusetts Institute of Technology, New York University, the University of Chicago, the California Institute of Technology, and the University of California at Los Angeles. This study will be followed by assignment of two months' active duty with the United States Weather Bureau. Some 200 students will be trained under this plan, which was developed by the Weather Bureau, the Department of State, the Office of the Coordinator of Inter-American Affairs and the Defense Supplies Corporation."

AN Associated Press dispatch reports that the council on medical education and hospitals of the American Medical Association has announced that the University of Georgia School of Medicine has been fully restored to its list of approved medical schools.

IT is announced that the New York Zoological Society is planning to establish a research center in the Zoological Park for the study of animal diseases in relation to human disease problems and a conservation exhibit. The society will receive $3,000,000 under the terms of a post-war program for the city.

DISCUSSION

AIR-AGE TEACHING OR MISINFORMING?

THE tremendous impetus given to aviation by the war has resulted in a veritable flood of books covering every possible phase of aviation, and ranging from popular treatises to text-books to be used for instructional purposes. One of the most ambitious of the latter is an entire series of books published by Teachers College, Columbia University, under the editorship of Dr. Ben Wood, professor of psychology. The editor writes in his introduction that this "Air-Age Education Series represents a major step in providing schools with teaching materials." One can certainly have nothing but praise for such a purpose, especially since the series is attractive in appearance and well written. However, a little closer examination of some of the volumes in this series reveals that their authors may have been enthusiastic but that they were also woefully uninformed about many fundamentals.

To wit: In "The Air-Age We live in," by Renner-Bauer, the following picture is drawn for us: The earth is not 8,000 miles but really 50,000 miles in diameter, the atmosphere ends at 21,000 miles above the solid surface because gravitation stops abruptly at that point. Oxygen and nitrogen cease to exist at altitudes higher than 80 miles, above which one finds only hydrogen and helium. At the top of the atmosphere the particles of air may be many feet apart, perhaps even miles, and the temperature up there is the same as that of interplanetary space—absolute zero. If a man were hauled up to the top of the atmosphere he would explode.

All these statements are not only wrong but they present striking evidence that the authors do not understand the principles of the physical universe. Thus, to mention but one point, they appear to confuse the average distance apart between particles with the mean free path, and when they give the pressure exerted by the ocean on a fish at a depth of five miles as 11,458 pounds per square inch, the 8 may be correct but the 4 is certainly wrong.

In "Globes, Maps, and Skyways" by Bauer the statements are made: ". . . that the shortest air route from Buenos Aires to Melbourne or from Auckland to Cape Town leads almost directly across the South Pole was perhaps an unexpected discovery." Very unexpected indeed because in both cases the great circle route misses the pole by more than 1,000 miles. The usually accepted dates of equinoxes and solstices are March 21, September 23 and June 22, December 22, not September 22, June 21, December 21. The "small correction" due to the fact that the Pole Star is not at the Pole is not small, but may amount to 70 miles. On page 62 the author makes the flat statement (and even draws a figure to "prove" it) that "the latitude of the observer equals the observed altitude of the sun plus its declination." If true, this would place the sun overhead at the North Pole on March 21—such a howler would by itself alone condemn the book and when the author modestly pontificates that the "principles of global flight which we have discussed in the preceding pages of this book should from now on be used in all geography courses so that revolutionary changes in world traffic may be fully understood," one can only comment: God forbid.

In "Human Geography and the Air Age" by Renner we are dealing with the outpourings of that great self-confessed genius who considers himself superior to all the "amateurs in the State Departments" in planning the post-war world and who thus, from all this wisdom, proposed to end all future trouble in the Balkans by giving Italy the entire Dalmatian Coast—doubtless as a reward for having first massacred most of the inhabitants. To find a person who claims to be a geographer, economist, historian, political scientist, linguist and transportation expert stating that the British built the Suez Canal, and that the Rhine Valley lies in Austria is quite a record. Mr. Renner is wont to complain about the fact that the British control all but one of the bottlenecks between oceans. The "bottleneck" between Cape Agulhaes and the Antarctic Continent is some 2,400 miles wide—"some neck," as Mr. Churchill might say—and it is also a good deal wider than that between Brazil and Dakar, which is not mentioned at all doubtless because it is not controlled by the hated British.

In the latitude of Hammerfest—70.7 degrees north—the earth's rotational speed amounts to about 340 miles per hour, instead of 250, and hence the entire elaborate simile built up on this falls flat. The statement about the aviator flying westward from Oslo on March 21, and thus having a day of 16 hours, and a night of only 8 hours shows a complete lack of understanding of relative motion.

"The World created by the Airplane can best be shown on a map which radiates outward from the North Pole." This would be fine for the Isolationist Eskimo Aviation Corporation with headquarters on an icefloe at the north pole, but since it is obvious that in the immediate post-war world air transportation will be centered around the U. S. the map should be drawn with the U. S. as center—if at all. The type of map claimed as "new" by Renner has been used by astronomers for centuries—only astronomers are well aware of its imperfections and distortions. On the map as given by Renner the distance from Cape Horn to Hobart, *e.g.*, appears to be 18,000 miles—

actually it is only 4,600. There are few places on a Mercator map that are as badly off as that.

A large part of the book is given over to a discussion of the war and its strategy. Herr Doktor Renner, who likes to refer to our general staff as composed of "admirals, generals and similar elderly people" assures us that these people suffer not from being blind but merely from hindsight, whereas it is intimated that the author combines the foresight of Columbus, Major General Haushofer and General Billy Mitchell. Mr. Renner speaks feelingly about illiteracy when referring to people who do not agree with him, and about "Tragic maps," *i.e.*, all maps that do not have the north pole at the center. The only statement that I can heartily agree with is his: "The ideas of uninformed people do not have much shape or dimension." Certainly the ideas of the uninformed amateurs of Teachers College are sometimes badly misshapen.

The authors of these three books have made a great discovery: the earth is round. So now they want to share this discovery with the rest of us who are merely illiterate believers in the tragic Mercator maps, and who possess only hindsight, if any. And all this has to be done with the magic word "global." The real tragedy lies in that these books come dressed up with copious references to the Civil Aeronautics Administration which will be mistaken by many still less-informed people as indication of approval by the C.A.A. There probably are few fields of education where the need for good, simple, but correct texts is as great as it is in aviation—in all of its aspects. If books such as these, containing a vast amount of misinformation, should be adopted in many schools, they could warp the thinking of countless students, and do untold harm to the future of aviation.

WILLEM J. LUYTEN
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SOMATIC MUTATIONS IN THE APPLE

SOMATIC mutations in apple varieties resulting in a change in the distribution pattern of the color in the epidermal cells of the fruit are quite common. Certain of these mutations are of increasing importance in nurseries and orchards. Most of these differ only in fruit color pattern and can not be identified by tree characters. Van Buren, which is reported to be a somatic mutation of the Duchess of Oldenburg variety, is an exception. It differs in many characters from its supposed somatic parent.

The McIntosh variety has produced many color mutations. Color patterns vary from distinctly striped to uniformly red with no trace of stripes or splashes. The type almost always comes true in asexual propagation. The striped form is generally regarded as the original, but there is evidence that the original McIntosh tree bore apples that were of a uniform red.

There are under propagation at the Massachusetts Experiment Station a considerable number of reputed mutations of the McIntosh apple. Two of them have been in nursery propagation for several years and produce apples that are of a uniform red and very similar if not identical in all fruit characters. They can not be distinguished by vegetative characters. Budded on most stocks, they behave alike, though one type known as Type G is sometimes a little slower than the type called R in starting growth from the inserted bud.

These two types were budded in 1941 on a clonal stock known as Spy 227. Both started growth normally in 1942, but by midsummer all the budlings of Type R were dead or dying, while those of Type G grew normally all summer. The varieties Stayman and Winesap, both on this stock, behaved much like Type R, Stayman budlings dying even earlier than Type R, while Winesap lived a little longer. It is remarkable that these two types, very similar and probably indistinguishable in all external characters, show such a striking difference in behavior when budded on this particular stock. The test is being repeated, including several additional types of McIntosh and varieties more or less related to the Winesap and Stayman.

J. K. SHAW
L. SOUTHWICK
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FRANZ BOAS, HIS PREDECESSORS AND HIS CONTEMPORARIES

IN her appreciation of Franz Boas (SCIENCE, 97: 2507, 60–62, 1943) Professor Benedict properly stresses the progressive shift in his anthropological interests and his unusual capacity for formulating problems so as to bring them nearer solution. However, two points in her article require further elucidation: one of them concerns Ratzel; the other, Boas's relations to predecessors and coevals.

So far as I can discover, Ratzel lectured at Munich and Leipzig, whereas Boas studied at Heidelberg, Bonn and Kiel. It is thus not clear how Ratzel can be called "his teacher." Incidentally, Ratzel was not nearly so intransigent an environmentalist as is commonly supposed.

Far more important is the second issue. We read: "He [Boas] found anthropology a collection of wild guesses and a happy hunting ground for the romantic lover of primitive things; he left it a discipline in which theories could be tested and in which he had delimited possibilities from impossibilities." Professor Benedict is of course entitled to her own reading of history. But unfortunately her statement might be mistaken for the general sentiment of a Boas

"school" and accordingly—after discussion with Drs. A. L. Kroeber and Paul Radin, two other one-time students of Boas—I feel compelled to register my vehement, uncompromising dissent.

To take only two predecessors, E. B. Tylor emphatically did not indulge in wild guesses nor did he collect anthropological facts as a philatelist collects stamps; and Lewis H. Morgan, his misconceptions to the contrary notwithstanding, created absolutely new lines of fruitful inquiry in which the "romantic lover of primitive things" would be very unhappy indeed.

As for contemporaries, Boas highly esteemed such men as Karl von den Steinen, Eduard Hahn, Eduard Seler; and irrespective of divergences of opinion he recognized the ability of Daniel G. Brinton and Wm. H. Holmes. The notion that he was a culture hero of the type featured by aboriginal folklore, a bringer of light out of total darkness, was intensely distasteful to him; he explicitly repudiated it in a letter to me (December 30, 1937). I have tried elsewhere to sketch Boas's unique services to science. They were sufficiently great not to require the belittlement of others, which must inevitably evoke legitimate resentment, ruffling national no less than personal sensibilities. *De mortuis nil nisi verum.*

ROBERT H. LOWIE

UNIVERSITY OF CALIFORNIA,
BERKELEY

SCIENTIFIC BOOKS

PHYSICAL CHEMISTRY

Elementary Physical Chemistry. By MERLE RANDALL and LEONA ESTHER YOUNG. xiv + 455 pp. Berkeley, Calif.: Randall and Sons. 1942. $4.50.

THE chief novelty of this text is the unusual arrangement of subject-matter. Early chapters deal with vaporization, distillation, solubility product, dissociation of electrolytes, hydrolysis and indicators. Gases are first discussed in detail in Chapter XIII; and as a matter of fact, from this point on the remaining material is presented in a more orthodox sequence. The purpose is ". . . to utilize the experiments performed by students in the elementary organic and quantitative laboratories as the basis of establishing the fundamental principles of modern thinking in this field."

The authorship guarantees a presentation with a strong thermodynamic bias, though this does not extend to a detailed discussion of the laws of thermodynamics. However, the language is the language of thermodynamics. The selection of material likewise betrays a preoccupation with thermodynamics or, more particularly, with the common equilibrium systems. Thus, such topics as atomic and molecular structure, crystal structure, colloidal systems and reaction mechanism receive only a legal minimum of attention.

Providing the remainder of the curriculum is closely attuned, this might be a very useful text. Helpful adjuncts are the numerous problems, tables and figures.

Experimental Physical Chemistry. By W. G. PALMER. xii + 321 pp. Cambridge, England: Cambridge University Press. 1941. $2.75.

THIS laboratory manual follows accepted lines for the most part. Chapters are devoted to densities of gases and vapors, crystallization and the properties of crystals, solutions and solubility, dilute solutions, thermochemistry, ionization, velocity of chemical reaction, surface chemistry. Optical instruments and their uses are not discussed.

Each experiment is preceded by a brief theoretical introduction. Detailed procedures are given, and there is usually a completely worked example. A point is made of the simplicity of the apparatus required. A number of the experiments are of a qualitative nature.

The text should be useful in an elementary course in physical chemistry, though it is not clearly superior to other texts on the market.

ROBERT N. PEASE

ORGANIC CHEMISTRY

The Quadri-Service Manual of Organic Chemistry. By EDWARD DEGERING. 221 pp. Houghton Mifflin Company. 1942. $2.50.

THE author has introduced a novel presentation of organic laboratory material and the scope of experiments included shows a definite shift from the traditional type of organic laboratory manual. The experiments are designed to cover the aliphatic and aromatic series and the planning is such that experiments may be chosen from both series for a one-semester course primarily for premedical students. The introduction of organic experiments on a semimicro basis is a valuable contribution and will no doubt impress upon the student the importance of maintaining his laboratory techniques throughout his organic chemistry training. Objective type tests are included throughout the manual primarily as a method of review. However, the value of these tests for the beginning organic chemistry student is a debatable question. The reviewer feels that the objective type tests in organic chemistry can be a teaching aid only after the completion of the elementary course in or-

ganic chemistry, inasmuch as this type of test trains the student only in his ability to recognize material once learned, while his training in being able to recall and apply his knowledge is neglected. Nevertheless, this organic laboratory manual demands the attention of every serious-minded teacher of organic chemistry.

ROBERT G. LINVILLE
COLUMBIA UNIVERSITY

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

DIGEST OF THE MINUTES OF THE EXECUTIVE COMMITTEE

POSTPONEMENT of the New York meeting, scheduled to have been held during the week of December 28, 1942, prevented the holding of the regular business sessions of the Executive Committee and of the Council at that time. Acting under a provision of the Constitution and By-Laws that "the Executive Committee shall have full power to act for the Council when the Council is not in session," the Executive Committee held a special meeting in Washington, D. C., on January 17, 1943, with eight of the ten members present, as follows: Drs. Livingston (chairman), Adams, Barker, Caldwell, Cannon, Compton, Moulton and Wrather.

The following actions were taken, all of which were by unanimous vote:

1. It was voted (a) that all work of the association, except the holding of general meetings, be continued until the holding of meetings is resumed, presumably after the close of the war; (b) that new officers of the association be elected by mail ballot of the council, a procedure that is valid under the constitution and by-laws of the association; (c) that joint local meetings with affiliated academies of science and joint local meetings of sections and affiliated societies be held when feasible; (d) that the special committees of the association be continued under the usual terms of tenure, and (e) that arrangements be made, if possible, for broadcasting addresses of retiring presidents.

2. In accordance with 1(b), it was voted that the council elect by mail ballot the president of the association for 1943, three members for the executive committee, two elected members of the council, and the vice-presidents for sections. (Report of the results of the balloting by the council, now in progress, will be published in SCIENCE.)

3. The following were elected a committee for the subsection on dentistry: Thomas J. Hill, chairman, 2085 Adelbert Road, Cleveland, Ohio; Paul C. Kitchin, secretary, Ohio State University; and B. Holly Broadbent, 2879 Fontenay Road, Cleveland, Ohio.

4. Glenn L. Jenkins, Purdue University, was elected chairman of the subsection on pharmacy for a three-year term, expiring at the end of 1945.

5. President Compton appointed R. G. Hoskins, Harvard University, and Henry Gilman, Iowa State University, as members of the grants committee, to represent medicine and chemistry, respectively, for terms ending at the close of the year 1946.

6. On recommendation of the finance committee, Charles S. Baker, Washington, D. C., was elected a member of the finance committee to succeed himself, for a four-year term ending at the close of the year 1946.

7. J. McKeen Cattell was nominated to succeed himself as a representative on the board of trustees of Science Service for a three-year term ending in April, 1946.

8. The Arkansas Academy of Science was accepted as an affiliated state academy and the American Association of Scientific Workers was accepted as an affiliated society.

9. The reports of the auditors (certified public accountants) of the accounts of the treasurer and of the permanent secretary for the fiscal year ended September 30, 1942, were accepted.

10. The executive committee approved the recommendation of the permanent secretary that in making arrangements for future meetings of the association the local committees in the communities in which meetings are to be held be charged with the responsibility of arranging for entertainment and excursions and providing clerical and other services, as heretofore, but be relieved from the onerous and disagreeable task of collecting funds for printing the general program and meeting other expenses.

11. The policy, in general, was adopted that hereafter grants for research shall be given only to applicants who have not previously received two grants from the association or from other sources in support of the research for which the application is made.

12. In carrying out certain terms of the agreement between the association and Dr. J. McKeen Cattell and Mrs. Josephine Owen Cattell, in so far as it concerns *The Scientific Monthly*, the permanent secretary was authorized and directed to accept the offer of Dr. and Mrs. Cattell and to pay \$9,499.59 in lieu of the annuity provided in the agreement, and Mr. Ware Cattell was elected as editor for a four-year term beginning January 1, 1943. The permanent secretary was also directed to publish *The Scientific*

Monthly in the name of the association and to accept the detailed unit cost estimate of the Science Press Printing Company for printing and mailing *The Scientific Monthly* for the calendar year 1943.

13. The following committees on resolutions were appointed:

(a) Resolution on interrelations of scientists of the Western Hemisphere. Dr. Walter B. Cannon was appointed chairman and Dr. E. C. Stakman was appointed a member of the committee. The chairman was authorized to appoint other members to the committee.

(b) Resolution in support of the war efforts of the Government. Dr. James B. Conant was appointed chairman, with authority to appoint other members to the committee.

(c) Resolution on freedom. Dr. Harlow Shapley was appointed chairman and Dr. Isaiah Bowman was appointed a member of the committee. The chairman was authorized to appoint other members to the committee.

(d) Resolution on declaration of scientific objectives. Dr. F. R. Moulton was appointed chairman with authority to appoint other members to the committee.

14. The following resolution in commemoration of the hundredth anniversary of the National University of Chile was adopted:

WHEREAS, the National University of Chile has recently celebrated its centennial, and,

WHEREAS, among its faculties are included many of the outstanding scientists of the Western Hemisphere, and,

WHEREAS, since science transcends national boundaries and forms part of a worldwide culture,

Therefore, be it resolved, in recognition of the identity of its interests with those of the distinguished scientists of the National University of Chile, and the strong cultural bonds that link the scientific workers of the hemisphere, that the American Association for the Advancement of Science send its felicitations to the National University of Chile and its rector, on the part of the scientists of the United States of North America, and,

Be it further resolved, That the American Association for the Advancement of Science, in anticipation of closer cooperation of the scientists of the hemisphere, cordially invite the university to take steps leading to such cooperation.

15. It was voted to cancel the New York meeting, previously postponed on request of the Office of Defense Transportation.

SPECIAL ARTICLES

ON ESTERS OF PENICILLIN[1,2]

THE chemotherapeutic effect of penicillin against the Gram-positive cocci in experimental animals and in man has been unequaled by any other agent so far tried. The practical use of penicillin, however, is still attended with some difficulties because of the instability and rapid excretion of the material. In a previous publication[3] we have described attempts to stabilize penicillin by selective acetylation and benzoylation of the hydroxyl groups. Though the stability of such derivatives, especially of the benzoyl compound, was greater than that of the original penicillin, the products held no great promise.

Since the instability of penicillin, especially in acid solution, is partly due to the lability of a carboxyl group,[4,5] experiments on esterification have been carried out by us during the past year and a half. The Oxford workers recently reported[4] unsuccessful attempts to esterify the silver salt of penicillin with alkyl iodides. We have prepared the methyl, ethyl, n-butyl and benzohydryl esters by reacting the free acid of penicillin with the corresponding diazo compound. In contrast to the starting material, the esters are insoluble in neutral or slightly alkaline buffers, they are very soluble in benzene and are not precipitated from chloroform-benzene solutions by dry ammonia. On analysis, the methyl and ethyl esters were found to contain around 10 per cent. of alkoxyl. Chromatographically the esters prepared from unfractionated penicillin showed three components.

In vitro the aliphatic esters have an activity of about 25 micrograms per cc in contrast to 0.08 to 0.3 micrograms per cc for the original penicillin fractions against hemolytic streptococci. The dilution method was used for these titrations.[6] The constant and low activity of the esters is probably due to a partial hydrolysis of the esters by the hemolytic streptococci.

The aliphatic esters show, in contrast to their relative inactivity *in vitro,* a marked activity in mice. Mice were infected by the intraperitoneal injection of 1 cc of 10^{-3}, 10^{-4} and 10^{-5} dilutions of a highly virulent strain of hemolytic streptococcus (C_{203}Mv). Treatment by the subcutaneous route was begun

[1] From the Departments of Ophthalmology and Medicine, College of Physicians and Surgeons, Columbia University, and the Edward Daniels Faulkner Arthritis Clinic, Presbyterian Hospital, New York.

[2] This work has been supported in part by a grant from the John and Mary R. Markle Foundation.

[3] K. Meyer *et al.*, SCIENCE, 96: 20, 1942.

[4] E. P. Abraham and E. Chain, *Brit. Jour. Exp. Path.*, 23: 103, 1942.

[5] Unpublished experiments.

[6] G. L. Hobby, K. Meyer and E. Chaffee, *Proc. Soc. Exp. Biol. and Med.*, 50: 277, 1942.

within two hours after infection and was carried out for a period of two to three days only. Table I shows the high degree of protection obtained with relatively small amounts of the ethyl ester.

TABLE I

Total amount of ester in mgs	Dilution of culture (strain $C_{203}Mv$)	Number of mice	Number died (< 48 hrs.)	Number survived (> 7 days)
2.5–4.5	10^{-3}	11		11
	10^{-4}	12		12
	10^{-5}	13	1	12
1.37	10^{-3}	3		3
	10^{-4}	3	1	2
	10^{-5}	3		3
0.6	10^{-3}	3	2	1
	10^{-4}	2	1	1
	10^{-5}	3	1	2
Controls	10^{-6}	12	12	
	10^{-7}	12	12	

A total dose of less than 1.5 mg of the ethyl ester gives complete protection against a 10^{-3} dilution (20,000 to 100,000 lethal doses) of hemolytic streptococci. With the methyl ester, essentially the same results have been obtained, except that a total of at least 2.5 mg was necessary. With penicillin preparations having an activity similar to that of the fractions from which these esters have been made, considerably larger amounts were necessary. The increased stability of the methyl and ethyl esters is illustrated by preliminary experiments indicating that partial protection is obtained by oral administration.

The benzohydryl ester mixture, in contrast to the aliphatic compounds, is hydrolyzed by the test organism. It has a constant *in vitro* activity of 0.3 to 0.6 micrograms per cc which is comparable to the activity of the starting material. The mouse seems to be unable to hydrolyze this compound, however, as no protection was obtained with the dosage employed. The compound is of interest, nevertheless, since it can be split by catalytic hydrogenation with colloidal palladium, giving a highly active acid fraction.

KARL MEYER
GLADYS L. HOBBY
ELEANOR CHAFFEE

THE INFLUENCE OF BIOTIN UPON SUSCEPTIBILITY TO MALARIA

IT has long been known that individuals differ in their degree of natural susceptibility to malaria. Almost nothing is known, however, concerning the factors responsible for these differences, nor has it been possible in the past to markedly affect the degree of natural susceptibility to experimental malaria, whether human, simian or avian. Experiments with avian malaria have now shown that the level in the host animal of biotin,[1] an important growth factor, greatly influences the severity of the infection. Also significant is the fact that the concentration of biotin in the blood reaches two or three times its normal value at the peak of an acute experimental malarial infection, and then returns to normal when the infection has subsided.

Most of the work has been done with *Plasmodium lophurae*[2] infections in young chickens and ducks. Chickens or ducks, rendered biotin-deficient by maintenance on an egg-white diet[3] for two or three weeks and subsequently inoculated with large doses of *P. lophurae,* showed peak parasite numbers 50 to 100 per cent. higher than those shown by control animals. Among the biotin-deficient animals, the parasite number persisted at a high level several days longer, and more animals died of the malarial infection than among the controls. The greater susceptibility of the biotin-deficient animals was not directly connected with any general weakness resulting from the biotin deficiency. Chickens or ducks made extremely weak on a pantothenic acid-deficient diet did not develop any heavier infections with *P. lophurae* than did the robust animals which received the same diet supplemented with calcium pantothenate. Moreover, chickens which were provided with just enough biotin so that they grew well and were quite normal, except for a mild scaly dermatitis of the feet, developed more severe infections than chickens provided with more nearly adequate amounts of biotin. Here, in the presence of a small degree of biotin deficiency, the administration of additional biotin acted as a specific therapeutic measure to lessen the severity of the infection. It is also pertinent that older chickens, which are more resistant to *P. lophurae* infection than young chickens,[2] showed a higher level of biotin in the blood.[4]

Chickens kept on egg white diet and infected with *Plasmodium gallinaceum,*[5] either by sporozoites or by blood inoculation, showed higher average peak parasite numbers in the blood than control animals on a similar diet with the egg white replaced by casein. Biotin-deficient ducks infected with *P. cathemerium*[6] did not show higher peak parasite numbers than the non-deficient animals, but their infections persisted at a high level for several days after the blood of the

[1] V. du Vigneaud, SCIENCE, 96: 455, 1942.
[2] L. T. Coggeshall, *Am. Jour. Hyg.,* 27: 615, 1938.
[3] R. E. Eakin, W. A. McKinley and R. J. Williams, SCIENCE, 92: 224, 1940.
[4] Total biotin (after acid hydrolysis by the method of J. A. Lampen, G. P. Bahler and W. H. Peterson, *Jour. Nutrition,* 23: 11, 1942) was determined by the microbiological assay method of G. M. Shull, B. L. Hutchings and W. H. Peterson, *Jour. Biol. Chem.,* 142: 913, 1942.
[5] The work with *P. gallinaceum* was done at the laboratories of the International Health Division of the Rockefeller Foundation with the generous cooperation of Dr. J. Maier.
[6] Duck strain 3 T kindly sent me by Dr. Fruma Wolfson.

controls was virtually free from demonstrable parasites. Several of the biotin-deficient ducks infected with *P. cathemerium* died from the infection.

In both chickens and ducks, whether on a deficient or an adequate diet, the concentration of biotin in the plasma and red blood cells rose during the course of infection with *P. lophurae*. This rise can not be explained solely on the basis of the new red cells formed in response to the anemia produced by the parasites. In ducks, an increased biotin level was already apparent by the fourth day after inoculation, when there was as yet no large proportion of young red cells; the increase appeared in the plasma as well as in the red cells; and both plasma and red cells were back to a normal biotin level by the eighth day after inoculation, when a large proportion of young red cells was still present. Since *P. lophurae* multiplies to a greater extent in animals with a relatively low initial biotin level than in those with a higher initial biotin level, the increase in biotin which occurs during the course of the infection may well be concerned with the elimination of the parasites from the blood.

Whether these findings with avian malaria apply to simian or human malaria can be determined only by extended observations on body biotin levels in these species in relation to the degree of susceptibility to malarial infection. Certainly the results with chickens and ducks would indicate that biotin is one substance of known chemical nature which helps to determine the degree of resistance of the host to infection with malarial parasites. These results are also of interest in that they provide an example, in addition to the very few thus far discovered,[7] of a specific relation between a nutritional deficiency and susceptibility to an infectious disease. The full details of this work are to be published shortly.

WILLIAM TRAGER

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RELATION OF FOOD INTAKE TO RESPONSE OF MICE INOCULATED WITH LANSING STRAIN OF MURINE POLIOMYELITIS VIRUS[1]

IN a recent preliminary communication[2] we reported that mice on a vitamin B_1-deficient diet showed increased resistance, over a period of 30 days, to the Lansing strain of murine poliomyelitis virus. Since then these observations have been confirmed, and in addition we have found that simple restriction of food intake will produce comparable results. In several trials, feeding of about 40 per cent. of the usual daily consumption definitely extended the time before the onset of paralysis and the time of death. To at least the twenty-first day after inoculation there was a statistically significant difference in deaths and cases of paralysis between the restricted groups and those fed ad libitum. This difference had disappeared by the twenty-seventh day.

In one experiment, 176 mice were divided into 6 groups. Group I received a synthetic diet (diet 100), Groups II and III a stock diet (diet 483) and Groups IV, V and VI a synthetic diet in which the relative amounts of all ingredients except carbohydrate were increased at the expense of the latter (diet 515). Groups I, II and IV were fed ad libitum and the other groups were given 1 gm of food per animal per day. On the third day of the experiment, Groups I to V inclusive were injected intracerebrally with a suspension of mouse brain infected with the Lansing strain of murine poliomyelitis virus. This amount of virus corresponded to between 500 and 1,000 fifty-per cent.-mortality doses. Group VI was injected with a suspension of normal brain. The cumulative percentages of animals dying and those showing paralysis by the tenth, fifteenth and twenty-first days after inoculation are given in Table 1. Any animals dying before the third day are not included in the totals.

Increasing the concentration of thiamin in the diet

TABLE 1

Group No.	No. mice 3 days after inoc.	Diet No.	Amt. of diet	Inoculum	Days after inoculation 10 Par.[1]	10 Death	15 Par.[1]	15 Death	21 Par.[1]	21 Death
					Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
I	16	100	ad lib	virus	88	94	88	100	88	100
II	35	483	ad lib	virus	80	94	80	100	80	100
III	39	483	1 gm	virus	10	10	33	28	56	67
IV	23	515	ad lib	virus	91	87	96	100	96	100
V	25	515	1 gm	virus	20	28	32	48	52	68
VI	23	515	1 gm	normal brain	..	26	..	39	..	44

[1] Paralysis.

[7] "Nutrition and Resistance to Disease," *Nutrition Reviews*, 1: 66, 1943.

[1] Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

[2] *Proc. Soc. Exp. Biol. and Med.*, 51: 215, 1942.

so that the amount consumed by the animals on the restricted intake was at least double that of the animals on the unrestricted intake did not increase the incidence of paralysis or death. The administration of 0.5 ml of 0.3 per cent. saline twice daily by stomach tube to the mice on restricted intake, likewise did not significantly alter the results.

From the data it appears that restricting the intake of either the complete ration or just the carbohydrate delays the manifestation in mice of infection with the Lansing strain of poliomyelitis virus.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLIFIED PROPYLENE GLYCOL DISPENSER FOR FIELD USE[1]

A CONSIDERABLE amount of work is in progress at the present time on the effectiveness of propylene glycol as an air disinfectant.[2,3] This agent is commonly employed in concentrations ranging from 1 gram per 5 million cc of air to 1 gram per 20 million cc of air[3,4,5] and is most conveniently introduced into the atmosphere by vaporization.

Because some of the suggested vaporizing equipment is rather elaborate and is not suited to large-scale field experiments, we have developed a simple device requiring no special materials for construction. It consists of an ordinary electric light bulb dipping into a beaker or tin can filled with propylene glycol. Preferably the unit is insulated to diminish heat loss by setting it in a larger container and packing paper into the space between the sides. A 10-inch electric fan is placed one or two feet away so that it directs an air stream across the liquid surface. The large heating area of the bulb eliminates the danger of local super-heating with consequent decomposition of the propylene glycol, and the inexpensiveness of the equipment makes it feasible to install as many units as may be necessary in order to maintain a given concentration of vapor.

In practice the rate of evaporation of propylene glycol from the vaporizers should be great enough to bring all the fresh air coming into the room to the concentration level desired. It is usually estimated that a closed room has 2 to 10 air turnovers per hour under ordinary circumstances. Therefore, if a room has a volume of 2,000 cubic feet and there are 5 air turnovers per hour it would require the vaporization of 14 grams of propylene glycol per hour to maintain a concentration of 1 part propylene glycol in 20 million parts of air throughout the room. A single 50-watt bulb immersed in 700 cc of propylene glycol with a surface area of 18 square inches accomplishes this. The output of a vaporizing unit can readily be increased to 100 grams per hour by the selection of proper wattage and surface area.

For any given set of conditions the rate of evaporation of propylene glycol is a function of the temperature at the surface of the glycol. As an approximate figure for calculations we have found that an increase in vaporization amounting to 5 milligrams per minute per square inch of surface accompanies each degree (C.°) rise in temperature over the range 80° to 110° C. Since propylene glycol vapor has a fairly high specific gravity, vaporizers should be placed at least six feet from the floor and a sufficient number of fans should be installed to insure thorough mixing. Otherwise the vapor will sink to the floor and lead to erroneous interpretation of experimental data.

THE PERSONNEL OF NAVAL LABORATORY RESEARCH UNIT NO. 1[6]

BERKELEY, CALIF.

[1] The opinions advanced in this paper are those of the writers and do not represent the official views of the Navy Department.

[2] O. H. Robertson, E. Biggs, B. F. Miller and Z. Baker, SCIENCE, 93: 213, 1941.

[3] O. H. Robertson, E. Biggs, T. T. Puck and B. F. Miller, *Jour. Exp. Med.*, 75: 593, 1942.

[4] T. N. Harris and J. Stokes, *Am. Jour. Med. Sci.*, 204: 430, 1942.

[5] W. Henle, H. E. Sommer and J. Stokes, *Jour. Pediatrics*, 21: 577, 1942.

[6] The Unit Personnel consists of the following members of the U. S. Naval Reserve: Albert P. Krueger, Commander, MC–V (S), officer-in-charge; Lieutenants L. E. Rosenberg and N. S. West; Lieutenants (jg) A. S. Browne, O. J. Golub, A. H. Jacobs and J. R. Mathews; Ensigns A. J. Glazko, M. D. Thaxter and H. M. S. Watkins; Chief Pharmacist Mate I. L. Schechmeister; Pharmacist Mates First Class W. L. Axelrod, E. R. Chisholm and G. B. Saviers; Pharmacist Mates Second Class H. R. Burkhead and C. R. Webb, Jr.; Pharmacist Mate Third Class J. A. Gray, Jr.; and Pharmacist Mate First Class P. J. Smith and Hospital Apprentice Second Class D. D. Metz, both of the U. S. Navy.

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SCIENCE NEWS

Science Service, Washington, D. C.

THORIUM

DISCOVERY of the rare radioactive element thorium in the sun is announced by Dr. Charlotte E. Moore, of the Princeton University Observatory, and Dr. Arthur S. King, of the spectroscopic laboratory at Mt. Wilson. The element was found to occur in the ionized state only.

Although search for thorium started in 1938, the investigation was hindered by lack of suitable experimental work on the spectrum of the element in the laboratory under different conditions of temperature and magnetic field strength. When such experimental work recently became available the search was begun anew and this time was successful.

The basis for the discovery was chiefly the detection of lines in the solar spectrum that matched the lines of thorium most easily produced in the laboratory and which are generally the strongest lines of an element. These are known as its ultimate lines and if they are absent it is hopeless to look for any others.

One line of thorium which stood out in strength above all others and was therefore believed to be its ultimate line coincided almost exactly with a faint unidentified line in the solar spectrum. Other strong lines of the ionized element could only be tentatively identified with solar lines. But as the very strongest line of thorium is represented so weakly in the sun the absence of the other lines is not considered surprising.

Two of the strongest lines of neutral thorium coincided with solar lines, but the agreement was believed to be accidental from another line of evidence. Since sunspots are about 1,500 degrees Centigrade cooler than the surface of the sun surrounding them, they should contain less ionized thorium and consequently more of the neutral atoms. Hence, if the lines really belonged to thorium, they should be strengthened in the spectrum of sunspots. But since the lines were not strengthened in the sunspot spectrum the investigators were forced to reject the coincidences as accidental.

SCIENCE, SOCIAL SCIENCE AND THE HUMANITIES

THE physical sciences, necessarily given priority in present-day training programs to meet the war emergency, will not dominate post-war education, Dr. James B. Conant, president of Harvard University, emphasized in an address before the New York Academy of Public Education. They will maintain the gains they are making, but the social sciences and humanities will have to catch up with them, to maintain a balanced and a livable world.

The old notion that there is a basic opposition between two kinds of training, and that one kind is parasitic on the other, was decried by the speaker. The real relation, he said, is not one of parasitism but of symbiosis—the kind of thing you have in a lichen, in which two quite different types of organism are mutually beneficial to each other.

Such a symbiosis has long obtained in human affairs, Dr. Conant continued. Historically, the system of political liberalism under which we live has made scientific advance possible; and in turn scientific advances have fed our sense of freedom. "If we are to have a free society on this continent we must continue to have advances in the fundamental sciences, and these advances in turn can take place only if man is free. The symbiosis must continue if this nation is to prosper. . . . Let no man who admires science or extols new industrial techniques look with favor on any abridgment of human liberty unless he wishes to encourage forces which will eventually destroy those things he values most." He emphasized the necessity for post-war planning, if only to avoid further wars: "We can not maintain a free society in a world in which we must face the terrible and disrupting burdens of modern war once every generation."

In concluding, he offered a five-point outline of a master plan for future research: (1) Provide an educational system which offers real equality of opportunity. (2) Find the exceptional men among those given this opportunity while they are still in training. (3) Give these men every advantage and facility in the way of machines and helping hands. (4) Be certain that there are many rival and independent groups competing for scientific and technical achievement, and that no group can long perpetuate itself. And finally, (5) Beware in times of peace of coordinating agencies with dictatorial powers—of ideas of a peacetime scientific general staff.

THE ACCURACY OF MEASUREMENT

THE 52,000-ton full-load displacement of the new "Iowa" class battleships may actually be as much as 52,052 tons or only 51,948 tons without any one knowing the difference. That a battleship can not be weighed with an accuracy closer than one part in a thousand, was pointed out by Dr. Harvey L. Curtis, of the National Bureau of Standards, in his address as retiring president of the Washington Academy of Sciences. By contrast, a kilogram weight (basic unit of the metric system, a little more than two English pounds) can be compared with another with an accuracy a little less than one part in a billion.

Biggest things and smallest things are most difficult to measure and weigh. A battleship is about the biggest lump of matter which human means can weigh directly. In the opposite direction, the antipneumococcus germ or virus particle is among the smallest of living things. It would require one octillion of these to weigh as much as a blue whale, largest of all animals. Far below this tiniest of germs, however, is the electron, smallest of all known objects. Its mass has been determined within an error of one per cent—but this is an accuracy of only one part in a hundred, as compared with one in a billion when kilogram weights are being compared.

As with weights, so with lengths. The standard meter

bar (the laboratory's "yardstick") can be compared with another meter bar with an accuracy of one part in ten million, perhaps under very favorable conditions to one part in fifty million. The error amounts to something between a twentieth and a hundredth of the diameter of a fine spiderweb.

Accuracy of comparisons falls off with either increase or decrease in lengths being compared. The standard base line used in the most accurate kind of surveying is usually 1,000 meters. Its accuracy, however, can be determined only to one part in a million, as compared with one in ten million for the single meter.

The millimeter (a thousandth of a meter) can be determined with an accuracy of only one part in a few hundred thousand. The distance between the nuclei of a hydrogen molecule is known only to one part in a thousand, while the diameter of a proton, the smallest known object, has not yet been determined within an error of less than one part in ten.

ALASKA HIGHWAY CONSTRUCTION

OLD-TIMERS in Alaska and the mountain country of western Canada declared that a road couldn't be built where the Army Engineer Corps planned to put it, but airplane reconnaissance found a way through, and "guts and tractors" built the road.

This, in a one-sentence summary, tells the story of the building of the Alcan Highway, which was presented at greater length before a joint meeting of the American Philosophical Society and the Geographical Society of Philadelphia on February 18 by Major Roswell P. Rosengren, chief of the Office of Technical Information.

The story of the road is a saga of decision, speed and determination. Only a little more than a year ago, on February 2, 1942, Brig. Gen. C. L. Sturdevant, of the Engineers, was told that a road was to be built and instructed to bring in preliminary plans. Forty-eight hours later he submitted them. He received from the Army High Command a directive on February 14 to proceed with the project.

The Canadian Government immediately gave informal permission for survey parties to go to work in their territory, and this was made formal on February 26. By March 10, American troops were arriving at the railhead at Dawson Creek, B. C., in temperature around 40 degrees below zero Fahrenheit. Further contingents reached other construction centers during April.

The route selected was criticized by local men who thought they knew the country because a considerable part of it apparently would have to traverse a 6,000 foot plateau. Actually, the airplane parties found a route no part of which had to climb above a 4,000 foot altitude. All of it lies in timbered country.

Several engineer regiments (one of them colored) tackled the job which looked like one to daunt Hercules. Each regiment moved up "heavy artillery" in the form of 44 big tractor-bulldozers, with scores of trucks, power shovels, piledrivers and other machinery; and of course the omnipresent, indispensable jeeps. The country fought the invaders with miles and miles of sullen muck and millions of mosquitoes. The road, as one writer put it, "was built as in battle, with every hardship except bullets." And the Corps of Engineers, U. S. Army, won their fight.

ITEMS

THAT the first sunspot of the new cycle may have already appeared, nearly a year before the end of the present cycle, it has been announced by Dr. Seth B. Nicholson, of the Mt. Wilson Observatory. The spot-group was visible for one day only on December 20, 1942, in the relatively high latitude of 32 degrees north, on the sun's surface. One of the most fundamental characteristics of the solar cycle is that toward the end spots are confined to a belt about 10 degrees wide on either side of the sun's equator. But when spots of the new cycle appear they are much farther from the equator than the old, usually above latitude 25 degrees, as was the case of the short-lived group of December 20. As a rule, the cycle to which a spot-group belongs can be decided definitely from its magnetic polarity as shown by the preceding and following members as they move across the sun's disk, the magnetic polarity of spot-groups of one cycle being opposite to those of the next. But in this particular case, the preceding spot was so little in advance of the other that it was hard to say whether the group should be classified as having a polarity the same as other spots of this cycle or not.

ABOUT three fourths of the moon was blacked out by the shadow of the earth on Friday night, February 19—the last lunar eclipse that will be visible in the United States until 1945. A nick appeared in the lower left edge of the moon three minutes after midnight. By 1:38 A.M. Saturday it was nearly immersed in shadow. A coppery glow covered the eclipsed portion because some light is bent into the shadow as the rays pass through the earth's atmosphere. Since blue waves of light are scattered by passage through the air, giving the sky its blue color, light which reaches the moon has a preponderance of red waves, causing the copperish hue. The eclipse was observed until 3:13 A.M.

THAT cold wave we've just been through wasn't a local affair. It covered pretty much the entire country east of the Rockies, according to the U. S. Weather Bureau. And it was the coldest weather we've had this winter. Temperatures ran as much as 12 degrees below normal, as contrasted with 10 or 15 degrees above normal during the previous week. Drops to 20 and 25 degrees below zero Fahrenheit were common in the north central states, and even as far down the map as central Georgia there were freezes at 10 or 15 degrees above zero. A good deal of harm may have been done to growing vegetable crops and dormant fruit buds in the South, but the extent of the damage has not yet been determined. Stock in the Northwest suffered from cold and deep snow, and there seems to have been some killing of uncovered winter grains, especially in the southern Plains region. And through it all, the Far West basked in temperatures well above normal for the season.

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OPPORTUNITIES IN MATHEMATICAL STATISTICS, WITH SPECIAL REFERENCE TO SAMPLING AND QUALITY CONTROL[1]

By Dr. W. EDWARDS DEMING

BUREAU OF THE CENSUS AND BUREAU OF THE BUDGET

Seed haunted by the sun never fails to find its way between the stones. And the pure logician, if no sun draws him forth, remains entangled in his own logic.
—*Antoine de Saint-Exupéry, The Atlantic,* March, 1942: page 328.

THE control chart was devised by Shewhart in 1924 to help disclose the presence of extraneous causes of variability that are worth looking for; also to give greater quality assurance in devising acceptance procedures (Problems B and A, respectively, as outlined below). If this were a group of business men, I might seize this opportunity to persuade you to make use of these methods. But speaking before mathematicians, I need not do that. Here we can talk about the next step, *viz.,* how to harness the efforts of mathematicians to statistical problems.

I shall remind you of two problems that confront the manufacturer and the statistician in industry:

Problem A: What to do with this lot? (Accept it, reject, pass, scrap, rework, or regrade it)
Problem B: What to do with the process? (Leave it alone; or look for some identifiable cause, make some adjustment, use different raw materials)

The quality control engineer does his best work in either problem when he recognizes the existence of both, and deals with both simultaneously. In par-

[1] An address given at a joint session of the Institute of Mathematical Statistics and the American Mathematical Society, Vassar College, on September 9, 1942.

ticular, the decision whether to accept or reject a lot of manufactured articles can not be dissociated from the question of control: is this lot one of a series of lots that were made in a state of statistical control? If the answer is no, each lot must be examined in considerable detail if its quality (average diameter or per cent. defective) is to be determined accurately. If the answer is yes, and if the lots are large, inspection of a small percentage of each lot, or of every k-th lot, will give the needed quality assurance. This *increased quality assurance* with *decreased inspection* is one of the advantages of the Shewhart methods.

The Shewhart methods are equally important in the social sciences, where a similar division of problems exists, though with some necessary modifications.[2] With the increasing number of surveys of local and national scope being carried out to supply data on the social and economic states of the population, and on natural resources and stocks, and with the ever-increasing need for accuracy in predictions, the requirements being placed on sampling methods and the interpretation of data are assuming increased severity. Recognition of the importance of sampling is one of the things that brings us together here.

Statisticians and mathematicians are rendering meritorious service in these critical times. I shall try to show you how they can render still more.

Variations in Nature

He who ignores the inherent variability of all nature does not understand nature. You may leave home at the same minute morning after morning, but you do not always arrive at your office at the same time. The peas in a pod are not alike, but they are usually alike enough for the purpose. Two telephones are not alike, but the variations are within limits that are known to be close enough and known in advance of production. Traffic accidents, deplorable though they are, do happen, and what is more, *will fluctuate week by week,* even under a constant set of causes. Likewise, a sentence will have various meanings, depending on who reads it. The meaning of anything that you say is the *action that it produces.* In attempting to write clearly you can only hope to narrow the spread of the interpretations—*i.e.,* of the actions or emotions that your writing gives rise to when readers read it.

I heard that the president of one large corporation was always anxious whenever the amount of scrap was greater one day than it was the day before. Now of course it is well to get interested in scrap, and the control of scrap incidentally offers one of the best uses of the Shewhart control chart; but if one looks for trouble in the plant every time the amount of scrap is higher one day than it was the day before, he will be looking for trouble far too often. It costs money to look for trouble. The amount of scrap is going to vary day after day even under controlled circumstances (*vide infra*).

[2] These remarks are extended in my paper in the *Jour. Am. Statistical Assoc.,* June, 1942, Vol. 37, pp. 173–185.

Definition of a Constant Cause System

A constant cause system may be described as one that produces numerical results that vary from one to another like a sequence of numbers that are drawn from a bowl of physically similar numbered chips, blindfolded, and with replacement and shuffling. Drawing from a bowl is the limiting attainable state of knowledge, which is to say, this is the limiting attainable state of stability.

The prime requirement of a constant cause system (a controlled process—*vide infra*) is stability, and hence the predictability of future percentiles or probability tolerances. It is important to recognize that a constant cause system does not produce constant results.

Randomness, Statistical Control and Technical Control

Any observation, measurement, or table of frequencies, comes about as the result of applying an operation. Whatever the operation, a repeated application thereof gives a new observation. Continued repetition gives a sequence of terms—a *population* of results. Thus, suppose an article is being manufactured, one after another, and let each be measured for its outside diameter. The situation is something like this—

$$\begin{array}{ll} \text{Article:} & F_1,\ F_2,\ F_3,\ \ldots,\ F_n \\ \text{Diameter:} & X_1,\ X_2,\ X_3,\ \ldots,\ X_n \end{array}$$

The manufacture and the testing and the recording of the diameters constitute the operation of obtaining the n values of X.

In the state of randomness or stability, the terms of the sequence behave as if they were being produced by a constant cause system—they behave as if they were being drawn from the bowl. Without stability, probability tolerances for future terms can not be set purely on the basis of past terms.

The attainment of randomness is much more difficult than is commonly supposed. It may require months. Statistical control is more than technical control. In the latter, the terms of the sequence are merely kept within certain bounds. Be they ever so narrow, this is not statistical control. Of course, technical control comes first, and is often sufficient.

A practical criterion of stability is the Shewhart criterion. If 25 or more successive points, each consisting of four consecutive terms of a sequence, fall within the control limits, after it is thought that all possible sources of extraneous variability have been

eliminated from the process that gives rise to the sequence, and if no trends or patterns are exhibited by the sequence, it is possible to set probability tolerances on future terms of the sequence, and thus to predict how much of tomorrow's product will fall within various limits—possible in the sense that experience, in many different kinds of production, covering many years, has borne out the advisability of so doing. I shall return to this topic later.

THE FUNDAMENTAL PROBLEM OF MATHEMATICAL STATISTICS

The fundamental problem of mathematical statistics is to set "probability tolerances," *i.e.*, to set limits within which 99 or some other per cent. of the next (*e.g.*) 1,000 or 10,000 terms of a random sequence will fall. For instance, on the basis of the past n diameters in the example cited above, the problem is to say what proportion of the next 1,000 or 10,000 diameters will fall within the limits X_1 and X_2. Failure of the putative percentage of terms to fall within these limits may be taken to indicate the presence of an "extraneous cause"—a cause not associated with the constant cause system identifying the random operation by which the past n terms of the sequence were generated.

The need for predictions in the form of probability tolerances as a basis for action is recognized much wider than it was a few years ago. Examples of action that are supposedly based on probability tolerances can be drawn from almost every field of scientific endeavor. For instance, no measurement, no survey, would be considered worth publishing unless there is evidence that repetitions would duplicate it within stated limits. Take government planning based on census returns; action can be based on the returns only if the census (whether by complete count or by sample) is carried out in such manner that repetitions of the survey, on or near the census date, would result in tables close enough to those that are actually published by the Census—*i.e.*, close enough for the purpose intended. The standardization of a drug is a problem in probability tolerances; dosage (future action) is based on the potency of the drug as determined by experiments which are carried out to make it possible to state in advance the limits within which 95 or 99 per cent. of the next 1,000 or 10,000 tests (results of doses) will fall. Recommendations regarding the planting of next year's crops should be based on predictions in the nature of probability tolerances for future yields, in terms of certain operations (variety, treatment, fertilizer). The prediction of ability for the selection of personnel calls for probability tolerances.

When probability tolerances for future terms of a random sequence are to be set on the basis of past terms alone, mathematical statistics is involved in the pure state—a problem of Type A as I have elsewhere classified the problems of statistical inference.[2] When the sequence is not random, the problem is not entirely mathematical, and may even be hardly at all mathematical; recourse must then be had to whatever knowledge there is concerning the underlying causes that make the terms of the sequence behave as they do. The problem is then one of Type B. The problem is partly or mostly Type B when there are not enough terms in the past, even though they are random, to allow probability tolerances to be set close enough for the purpose by mathematics alone. Often there is only one term, one result, one experiment; the rest is knowledge of the subject-matter.

THE SHEWHART CONTROL LIMITS ARE ACTION LIMITS; THEY STRIKE AN ECONOMIC BALANCE BETWEEN TWO KINDS OF ERRORS

Briefly, the Shewhart methods consist of studying a sufficiently large quantity of data, not as a single sample, but in a sequence of rational subseries that are obtained by breaking up the data in a manner that will indicate with a minimum amount of data the presence of extraneous causes, and the existence of stability when stability exists between the subseries. The most useful way of breaking up the data into subseries must be determined in each problem by knowledge of the subject-matter, but there are some guiding principles to keep in mind. It is important to collect the data and plot the points without delay, in order that action can be taken in time to ward off trends that are not wanted.

The presence of extraneous causes worth looking for is indicated by failure of a point on the control chart to fall within the "control limits." The problem of setting probability tolerances and control limits is a problem in action: What to do? to look or not to look for an extraneous cause? There must be an economic balance struck between the two kinds of errors—looking for trouble that does not exist, and failing to look for trouble that does exist.

There is not time here to tell you how to go about calculating and plotting a control chart and how to draw the control limits. I can use my time to talk about principles. The routine is simple enough, but a good many hours are required to become familiar with it. Fortunately, with the publication of the American War Standards,[3] and Colonel Simon's book,[4] it is possible now to point to a pretty full account of the steps in application.

[3] See references further on.
[4] Col. Leslie E. Simon, "An Engineers' Manual of Statistical Methods," John Wiley, 1941.

What Opportunity is There for Mathematicians?

In talking to a group of mathematicians I should like to seize this opportunity to point out where future emphasis in mathematical statistics must be directed if the present needs of the country are to be met. The accompanying diagram shows what part of the field has been tackled, and what remains. Most mathematical statistics has so far dealt with the central part of this diagram, where randomness exists—statistics *in vitro*. There are exceptions; Professor Wilks,[5] for instance, has made excursions of far-reaching importance into the right-hand part.

Randomness attained here ↓ Present ↓

Past		Future
Randomness being attained here, perhaps requiring months. The Shewhart methods assist, but so far there is but little mathematics, though there is some (theory of runs; the Wallis-Moore test). More mathematics needed.	Randomness exists here. Statistical distribution theory applies. Here is where most of the mathematical work has been done. More needed.	Predictions required in the form of probability tolerances, as a basis for action, and for identifying extraneous causes. The Shewhart methods work; also the mathematical methods of Wilks. More mathematics needed.

Diagram of the Statistical Study of Causes

The practicing statistician welcomes all the distribution theory that has been developed to date. Far from there being too much mathematical statistics, even in the state of randomness there is not enough! With more time I could describe, for instance, some fascinating unsolved problems in distribution theory of great economic importance, and of extreme difficulty, that have arisen in the work of the Census.

Mathematicians have too often assumed that it is easy to produce random variates. It is easy to assume that, and the problems are interesting. Of course, not everything is or should be useful, and we should be thankful for that, but the usefulness of much mathematical work in statistics has often been greatly overestimated because randomness is presupposed, with no indication given to show how far the calculations are invalidated by lack of randomness and what to do in the absence thereof.

Urgent requirements of government and industry now challenge the best mathematical talents in the country. In spite of the volumes of texts and periodicals that have appeared in the statistical field, there are parts of the subject yet untouched—one could almost say yet unrecognized. The need is urgent: the opportunity is great. New tools, new channels of thought are being called for. For one thing, the new mathematical developments in the left-hand side of the diagram must take account of the *order of the observations,* as is already done in the theory of runs and in the Wallis-Moore test, for example.

The requirements of the present and immediate future, when recognized, may turn out to be the sun that draws forth the best efforts that mathematicians have to offer.

Other Future Requirements

In the future there will be increased attention to the operational point of view, by which I mean that statements made by statisticians will of necessity be confined more and more to statements that theoretically at least can be subjected to test, because their statements will be tested.

The Shewhart methods were devised for the two extremes, right and left, in the diagram. The Shewhart methods work! In the future, mathematicians will show why these methods work and will then set out to improve on them. Meanwhile, it is important that men in government and industry be taught how to use them (*cf.* the last section).

Theoretical statisticians have too often evaluated the methods of quality control in terms of their own theories, without stopping to acquire an appreciation of the problems that face the practicing statistician, who must stand by and see his predictions put to a test. For instance, I have seen it argued (innocently enough) that people in quality control ought to use the nomenclature and language of the theory of estimation.

There will be increased attention to the distinction between chance as defined *a priori* as a basis for theoretical calculations in probabilities, and the meaning of the word chance when it is used to designate relative frequencies predicted to fall within certain limits in a controlled experiment. Calculated chances are one thing, but actual observed frequencies, even under a constant cause system, may be another. In other words, it is necessary to recognize the distinction between what is in the bowl, as determined by some standard method of examining part or all of the chips, and what we get by performing some other operation on it. One can not set probability tolerances regarding the results of drawing from the bowl, purely from knowledge of what is in the bowl as determined by some standard method.

For example, the phenomenon of the undercount of children under 5 is well known among sociologists.

[5] S. S. Wilks, *Annals of Mathematical Statistics*, 1941: pp. 91–96. At the Vassar meeting Professor Wilks expounded and extended his published work.

Whether the census is taken by complete count or by sampling, the undercount of young children makes its appearance. How do we know? In the same manner in which it was discovered many years ago. In the census 10 years hence, with allowances for deaths, and for in and out migration, there will be more children of age 10–15 in any sizable area than there were children of age 0–5 ten years before. The phenomenon invariably repeats itself, in this country and elsewhere. People just will forget the baby when the Census man comes!

In this illustration, the count 10 years hence is the "standard measurement." The census method of counting the children of age 0–5 at the date of the first census is the other operation. If it were repeated at small intervals of time, it would perhaps show statistical control. Suppose it does: neither the average result nor the probability tolerances for this "other" operation can be determined *a priori* by the standard count. Likewise the converse: it is too much to hope that the standard count could be determined by the average result or the probability tolerances for the census operation of counting children of age 0–5.

SOME REMARKS ON THE PRACTICE OF STATISTICS

Faced with realities, it is sometimes difficult for the practicing statistician to frame his problems in the language of the theoretical statistics that has so far been developed. The problem of attaining control, for example, is not analysis of variance, is not a test of significance, is more than a problem in probabilities, and more than a problem in the statistical testing of hypotheses in the usual sense. It is a problem in *action*. The control limits must provide an answer to the question: What to do? Shall we or shall we not look for trouble? An economic balance must be struck between two kinds of errors (*supra*). The question is not whether an extraneous cause is operating to make a point plotted from inspection data fall where it does (inside or outside the control limits): the question really is *whether it pays to look* for an extraneous cause (trouble).

WHAT CAN BE DONE?

Now is the time to do something. Statisticians have a great deal to offer. Let them bring it forth. The following 7-point plan is offered as a starting point, to be replaced by better suggestions as experience develops.

i. *Intensive courses in quality control.* By intensive I mean intensive, covering 7, 8, or 10 days, including Sundays, 8 hours per day. Stanford University gave such a course in July, and another in September. Thirty-two picked delegates from industry attended in July, and 31 in September. They were not just college students or graduate students who might some time go into industry and have use for the course. As I say, *they were already in industry.* Most of them were well advanced in their organizations, with authority to try out statistical methods, and they went home with the ability to do so. The 80 hours' instruction was sufficient to give them an excellent start. All phases of the subject were taught, including diagnosis of data brought to the conference, and arrangements for continuation study afterward. The instructional staff at Stanford was supplemented by practical men from government and industry—a vital necessity in such undertakings.

Something similar is being done in Great Britain, and can be done by other institutions of learning in this country. A semester course in quality control is good so far as it goes, but it is not sufficient for the present needs. It is too slow, and the yield too low. The important thing is to give intensive courses to men in industry, now, patterned after the ones at Stanford.

The Ordnance Department some months ago commenced an educational program in quality control under the direction of Mr. G. D. Edwards, of the Bell Telephone Laboratories, who with Mr. H. F. Dodge, of the Bell Telephone Laboratories, and Mr. G. Rupert Gause, of Colonel Simon's staff at Aberdeen, are holding three-day schools for ordnance people in a number of key cities.

With the close relation between price control and quality control, and the necessity for quality determination and the standardization of textiles, foods, drugs and hospital supplies, the need for expert statistical work in this line is multiplied manyfold under present conditions.

The Farm Management Statistical Clinic held under the guidance of Professor H. C. M. Case at Urbana in September, 1941, was an example of a step in this direction.

ii. *Intensive courses in other fields.* Fields other than quality control could be covered by intensive courses for the benefit of men in government and industry. For example, something could be done in the way of teaching statistical methods in psychological tests for placement of personnel.

iii. *Modification of instruction in regular courses.* In regular courses of instruction, students have often been given an incomplete picture of the problems of mathematical statistics. The middle part of my diagram has been taught, and rightly so, but the student has not realized that he was being taught in only this limited portion. The result has been over-confidence in his ability, nonsense calculations and outright mistakes that might be serious if not caught, with consequent mistrust of statisticians. Of course, it is impossible to equip a student of statistics with all that he is going to need, and to give him full directions about just what to do in every situation. Every problem requires intricate tailoring of general principles. This will always be true, but the teaching of general principles has not been broad enough, and what is worse, the student has not been advised and warned of his deficiencies.

iv. *Short monographs on various statistical procedures.* All over the country I have found men in industry, in government and in research organizations eager to learn the tools that the statisticians have developed. From

everywhere comes the question: "Where can I learn more about this? Is there anything printed in simple language that I can understand?"

Here again, something can be done, and is being done. I can refer you, for instance, to the American War Standards in the field of quality control. With remarkable foresight, perceiving the coming need for statistical methods in war industries and ordnance inspection, the War Department in December, 1940, asked the American Standards Association to develop concise treatments for the application of statistical methods, for use both in acceptance inspection, and during manufacture. A committee was appointed, with the result that two standards appeared in May, 1941, and a third in July, 1942, with titles as shown below:[6]

1. Guide for Quality Control, 1941
2. Control Chart Method of Analyzing Data, 1941

(Nos. 1 and 2 are bound together and sell at 75¢)

3. Control Chart Method of Controlling Quality During Production, 1942: 75¢.

These serve as guides in application and for introductions to texts and other books on the subject, and they contain references to texts and monographs on the subject for further study. Similar brochures on procedure could be produced for other statistical techniques.

v. *References to current articles and books in various fields.* The Institute of Mathematical Statistics and the American Statistical Association could perform a valuable service by running in each issue of their journals a list of references to current articles and books on applied statistics, broken down into various fields—sampling in social and economic surveys, quality control, psychological tests, presentation of data, and other subjects. Promptness is more necessary just now than completeness. Work should be commenced at once, with a three months' deadline for the first list, which should be an attempt to show important articles and books that will be helpful to statisticians in practice. The list would be kept current, and omissions filled in, by lists in subsequent issues.

Not all statisticians take the journals. The lists should be offprinted and advertised for sale separately: people would be glad to pay for them; the question is where can they buy them? Offprints of this nature, readily obtainable, would be excellent advertising for both the association and the institute, because they would show the public that these organizations are alive to present statistical needs and are perhaps worth belonging to.

Here is a splendid opportunity for some one not already overburdened by war work to get into it. The project could even be expanded, by the right person, to provide abstracts or films of foreign or rare articles worth looking at.

vi. *Exposition of methods in published articles.* In both journals, there could be more serious attempts to show the reader how to apply the methods that are presented. No matter how theoretical an article may be, it should nevertheless describe how its contents affect present practices. It should contain directions for application, plainly marked, "Step 1, Step 2, do this, do that, . . ." The hypotheses and conclusions and logic should be described in non-mathematical terms, as well as by strict mathematics. In other words, when a writer has something useful, he should say so, and make it possible for others to see why and how to use it. Incidentally, he should not expect the editor to do this for him.

vii. *Expert assistance.* This is the most vulnerable of my suggestions, but I think that some good might come of it, even if it leads to numerous failures. The fact is that there are not enough good men in applied statistics nor in mathematical statistics. There never have been. Right now, all over the country, there are young men grasping, groping, struggling with statistical problems on which action will be taken on a deadline. To whom can they look for assistance? If it could be made known, and if we were prepared, the association and the institute could assist by acting as a clearing house for statistical questions, by referring them to the right man, or by sending the names of experts who can and will go outside of Washington, New York, Chicago, and a few other places, and get their hands dirty. Expenses and a consulting fee would of course be paid; that presents no difficulty. What we need is some one in one or both of the organizations to take active charge of this project.

OBITUARY

EARLE RAYMOND HEDRICK

PROFESSOR EARLE RAYMOND HEDRICK, vice-president and provost of the University of California at Los Angeles, emeritus, died on February 3, 1943, at Providence, R. I.

He was born at Union City, Indiana, on September 27, 1876. He attended the University of Michigan (A.B., 1896), and was Parker Fellow from Harvard (A.M., 1898) at the University of Göttingen 99–01, receiving his Ph.D. in 1901. He attended the École Normale Supérieure, Paris in 1901. Dr. Hedrick was an instructor in mathematics at Yale University from 1901 to 1903, and professor at the University of Missouri from 1903 to 1924. He was professor of mathematics at the University of California at Los Angeles from 1924 to 1937, and served as provost and vice-president from 1937 to 1942. Since October, 1942, he was visiting professor at Brown University.

Throughout his life he was always greatly interested in the teaching of mathematics from secondary school to graduate school. In collaboration with the late C. A. Noble he translated the first third of Klein's "Elementarmathematik vom höheren Standpunkte

[6] Published by the American Standards Association, 29 W. 39th Street, New York. Reissued in Great Britain by the British Standards Institution, 28 Victoria Street, London, S. W. 1. The committee consisted of H. F. Dodge, Leslie E. Simon, W. Edwards Deming, Ralph Wareham, A. G. Ashcroft and John Gaillard.

aus," which rendered great service to teachers of mathematics in this country. A similar service was also rendered by his publication (with the late O. D. Kellogg) of "Applications of Calculus to Mechanics," in 1909. He was author of a college algebra and editor of some 25 volumes in the Series of Mathematical Texts.

But the most important activity during most of this long period was as member or director of various national organizations. He was one of the founders and the first president of the Mathematical Association of America, an organization which has moulded the development of collegiate mathematics since its foundation in 1916.

His contribution to the American Mathematical Society may be summarized by stating that he was editor-in-chief of its *Bulletin* from 1921 to 1937, a member of its board of trustees three full terms of five years each, president from 1929 to 1931 and representative of the society in the National Research Council from 1931 to 1934. Volume 44 of its *Bulletin* was dedicated to him.

Mr. Hedrick was married to Helen Breedon Seidenstricker on October 21, 1901, who, with eight children and one adopted daughter, survives him. Their home in Los Angeles has long been a welcome center for various social activities.

The American people and humanity generally suffer a great loss in the death of this man. Although always tremendously active, he never failed to give time and sympathetic interest to the affairs of a host of friends.

VIRGIL SNYDER

BROWN UNIVERSITY

RECENT DEATHS

DAVID GROSH THOMPSON, geologist of the U. S. Geological Survey, known for his work on the development of water supplies from underground sources, died on February 19 at the age of fifty-four years.

DR. FRANCIS J. POND, professor of chemistry and director of the Morton Memorial Chemistry Laboratory of the Stevens Institute of Technology, consultant in chemical research, died on February 18 at the age of seventy-one years.

LIEUTENANT COMMANDER FRANK K. MOSS, of the United States Naval Reserve, died on February 16. He was forty-four years old. Since 1933 he had been research physicist in the lighting research laboratory of the General Electric Company at Nela Park, Cleveland.

Nature reports the death of Sir Arbuthnot Lane, the well-known surgeon, on January 16, aged eighty-six years, and of Sir Henry Maybury, president in 1933 of the British Institution of Civil Engineers, on January 7, aged seventy-eight years.

DR. C. C. FARR, F.R.S., emeritus professor of physics at Canterbury College, Christchurch, the University of New Zealand, died on January 27 in his seventy-seventh year.

THE death is announced of Dr. David Hilbert, professor of mathematics at the University of Göttingen. He was eighty-one years old.

SCIENTIFIC EVENTS

POST-WAR FOOD SUPPLIES

IN a report prepared by allied agricultural experts and considered by the British Technical Advisory Committee on Agriculture in London, it is stated that the estimated decline of livestock in enemy-occupied allied countries as a result of lack of feeding-stuffs, requisitioning and slaughter is about 11,000,000 cattle, 3,000,000 horses, 12,000,000 pigs and 11,000,000 sheep. The *Times*, London, points out that the decline constitutes a very serious menace both to post-war food supplies and to the future of European agriculture. Milk production has gone down by more than a third, and meat production by nearly half. Recovery to pre-war numbers of breeding animals will take many years, and the lack of draught animals may be a serious hindrance to cultivation for the first post-war harvest.

Only a small proportion of this huge livestock loss could be made good by the supply of live animals. The first need will be for a policy of conservation of livestock, for the preservation of all animals capable of breeding and for the supply of an equivalent quantity of meat from overseas. At the same time feeding-stuffs will be needed, as well as veterinary measures to check the spread of epidemics among livestock already weakened by undernourishment. In countries where the numbers of draught animals have declined below the minimum needed for cultivation it may be necessary to replace them with tractors.

In connection with this last problem, the Technical Advisory Committee has taken note of the probable need to introduce mechanical cultivation into countries where few agricultural engineers or mechanics are to be found. The committee has therefore recommended provision for the training of allied nationals in Britain, such training to include tractor-driving, maintenance and the organization of mechanized services in agriculture generally.

MATHEMATICAL TABLES

A new quarterly publication of the Division of Physical Sciences of the National Research Council, "Mathematical Tables and Aids to Computation," edited on behalf of the committee on mathematical tables and aids to computation by the chairman, Raymond Clare Archibald, will serve as a clearing-house for information concerning mathematical tables and other aids to computation.

Tools for computation have been greatly multiplied, especially during the past decade. These tools, or accounts of them, are to be found in the international range of book, pamphlet and periodical publication, not only in the fields of pure mathematics, physics, statistics, astronomy and navigation, but also in such fields as chemistry, engineering, geodesy, geology, physiology, economics and psychology. An attempt will be made to guide varied types of inquiries to such material.

The chief parts of each issue will normally be devoted to Articles, Recent Mathematical Tables (critical reviews), Mathematical Tables—Errata, Unpublished Mathematical Tables, Mechanical Aids to Computation, Notes, Queries, Queries-Replies.

It is hoped that through this quarterly workers in different fields may become conversant with published and unpublished mathematical tabular material and that the critical surveys of all tables in special fields may be especially useful. The corrections of errata in standard tables of importance and the publication of proofs of unreliability of other well-known tables ought also to save much misdirected effort. It is the belief of some members of the committee that such a publication may contribute to the war effort and become a permanent record of importance.

CONFERENCE ON ATTAINING MAXIMUM EFFECTIVENESS OF INSECTICIDES AND FUNGICIDES

A conference was held in Columbus, Ohio, on February 14 to discuss the possibilities of stretching supplies of war-short fungicides, such as copper and mercury, and scarce insecticides, such as rotenone and arsenicals, by reducing dosages and increasing the efficiency of applying the unavoidably small amounts. Data on the subject were obtained by entomologists and phytopathologists in a number of state and federal experiment stations during the past season. The conference was scheduled originally for the New York meetings of the American Association for the Advancement of Science as part of the program of the American Association of Economic Entomologists, the American Phytopathological Society and the Biometrics Section of the American Statistical Association. It was held at this time so that the conclusions would be available before the coming growing season, and participants could attend in conjunction with committee meetings of one of the constituent societies and related groups, which were held in Columbus on the preceding two days. The conference was aided by the cooperation of the National Research Council and several state and federal agencies.

More than 50 attended the conference, and many interesting phases of the relationship between dosage and pest control were discussed. Particular emphasis was placed on the utilization of the dosage-response technique in comparing (1) two or more materials or mixtures of materials and (2) different methods of application of the same materials. Suggestions for designing experiments to utilize dosage-response methods in 1943 are being prepared for distribution to participants in the conference and others who may be interested. A report of the results for 1942 will be issued later when the statistical analyses have been completed. Copies of these reports may be obtained by writing to the chairman of the conference, the undersigned, at Box 1106, New Haven, Connecticut.

C. I. Bliss

RARE CHEMICALS

The following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.:

1. Diethylmonobromogold
2. Paredrine Hydrobromide
3. d-malic acid
4. Glycuronic Acid
5. Ostruthin
6. Methoxycaffeine
7. Glyoxylic Acid
8. Thallium Bromide
9. Thallium Iodide
10. Antimony Triiodide
11. Thymus nucleic acid
12. o-nitrobenzaldehyde
13. p-Naphthylhydrazine hydro-chloride

TECHNICAL AND SCIENTIFIC POSITIONS WITH THE GOVERNMENT

Men and women are sought to fill positions as technical and scientific aids in the Federal Government. They are needed to do research and testing in the following fields: chemistry, geology, geophysics, mathematics, metallurgy, meteorology, physics and radio. The positions pay from $1,620 to $2,600, plus overtime.

Applicants may qualify through experience or education. For the assistant grade, applications will be accepted from persons who have completed one year of paid experience or a war-training course approved by the U. S. Office of Education. One year of college study, including one course in the option applied for,

is also qualifying. Persons now enrolled in war-training or college courses may apply, subject to completion of the course. For the higher grades successively greater amounts of education or experience are required.

The majority of positions are in Washington, D. C., but some will be filled in other parts of the United States. There are no age limits, and no written test is required. Applications and complete information may be obtained from first- and second-class post offices, from civil service regional offices and from the commission in Washington, D. C. Applications will be accepted at the U. S. Civil Service Commission, Washington, D. C., until the needs at the service have been met.

Trainee positions in technical and scientific work will be filled in Washington, D. C., and vicinity. The salary is $1,440 a year plus overtime, and the only educational requirement is that the applicant must have completed one high-school credit of physics, chemistry, mathematics, biology or general science. There are no options.

Persons using their highest skills in war work are not encouraged to apply. War manpower restrictions on federal appointments are given in Form 3989, posted in first- and second-class post offices.

ATTITUDES OF STATE ACADEMIES TOWARD WARTIME MEETINGS

IN an effort to discover the attitude of other state academies toward meetings during wartime, and possible action regarding election of officers and publication of papers in the event of the cancellation of a meeting, Secretary V. Earl Light, of the Pennsylvania Academy of Science, questioned secretaries of all academies affiliated with the American Association for the Advancement of Science.

Twenty replies have been received to date, the majority of them reporting that meetings will be held this spring. Encouraged both by the nature of these findings and by a canvass of a sampling of its members, the executive committee of the Pennsylvania Academy of Science decided to hold its nineteenth annual meeting in April.

The following academies plan to meet this year: Alabama, Colorado, Wyoming, Illinois, Kansas (seventy-fifth anniversary meeting), Kentucky, Louisiana (one day meeting), Michigan, Missouri, North Carolina, Ohio, Pennsylvania, Texas, Wisconsin and Washington, D. C.

An Indiana Academy meeting is "probable"; Tennessee and Virginia are reported "undecided." Two states listed meetings as doubtful; New Hampshire (did not meet in 1942) and West Virginia. Only three academies replied that meetings definitely would not be held: Mississippi, Northwest and South Carolina.

Secretary R. F. Paton, of the Illinois Academy, expressed what appears to be a general conviction that "state meetings are most important since the national meeting was cancelled."

In the event that no meeting is held, most academies indicated that they would follow the practice of the American Association for the Advancement of Science in retaining present officers. New Hampshire plans to elect new officers by mail ballot.

Continuation of publications may be anticipated on the basis of replies. Mississippi and South Carolina probably will not issue their journals, while West Virginia expects to postpone publication for at least a year. For the first time, several states will accept for publication articles which have not been presented at a meeting of the academy.

The Pennsylvania Academy has shortened its program; it has cancelled its annual banquet and transferred its scheduled meeting from the overcrowded Philadelphia area to more centrally located Harrisburg. The usual submitted papers have been dispensed with, and its program has been organized around reports of state agencies and departments on the role of research in the war and in post-war planning. The meeting of the Pennsylvania Junior Academy of Science has been postponed, but the Senior Academy has undertaken a broad program of assistance for high-school science clubs.

CHARLES E. MOHR,
President, Pennsylvania Academy of Science

PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twenty-seventh annual meeting of the Pacific Division of the American Association for the Advancement of Science will be held from June 14 to 19 at Oregon State College. The executive committee met recently to consider the plans tentatively formulated during the past six months for the Corvallis meeting. Attention was given to the difficulties which have arisen during the past year in respect to the holding of conferences in general. After careful examination of the whole problem, and in the light of communications received from the Office of Defense Transportation, the Science Committee of the National Resources Planning Board and other organizations and individuals who have devoted thought to this problem, the executive committee voted unanimously to approve the holding of the meeting and to confirm the arrangements which have been entered into to date. Of three general addresses which will be presented in the course

of the meeting, one will be by Professor Linus Pauling, president of the Pacific Division, on "The Relation of Molecular Structure to Biology and Medicine," and the second by Professor Agnes Fay Morgan, of the University of California, who will speak on the subject of "Nutrition in Wartime." Arrangements for the third address are incomplete.

The morning of Tuesday, June 15, will be devoted to a general symposium on the subject "A Century of Science in the Pacific Northwest," in which three papers will be contributed in the fields of agriculture, forestry and engineering.

A session devoted to reviews of current research will constitute the program of Tuesday afternoon. Four speakers will outline recent advances in the fields of genetics, botany, zoology and mathematics.

The following affiliated organizations have indicated their intention to participate in the meeting:

Organization	*Secretary or Program Chairman*
American Association of Economic Entomologists, Pacific Coast Branch	Roy E. Campbell, Alhambra, California
American Association of Physics Teachers	C. J. Overbeck, Northwestern University
American Association of Physics Teachers, Oregon Section	E. H. Collins, University of Oregon
American Chemical Society, Pacific Intersectional Division	E. C. Gilbert, Dept. of Chemistry, Oregon State College, Corvallis
American Geophysical Union Section on Hydrology	J. C. Stevens, Spalding Building, Portland, Oregon
American Mathematical Society	A. D. Michal, California Institute of Technology, Pasadena
American Phytopathological Society, Pacific Division	C. E. Yarwood, Division of Plant Pathology, University of California at Berkeley
American Society of Plant Physiologists, Western Section	D. I. Arnon, University of California at Berkeley
Association of Pacific Coast Geographers	J. W. Hoover, 1224 S. McAllister Avenue, Tempe, Arizona
Botanical Society of America, Pacific Section	Bassett Maguire, Utah State Agricultural College, Logan
California Academy of Sciences, Committee on Natural Illumination	O. P. Jenkins, Division of Mines, State of California, San Francisco
Ecological Society of America, Western Section	H. de Forest, University of Southern California, Los Angeles
Oceanographic Society of the Pacific	C. L. Utterback, University of Washington, Seattle
Oregon Psychological Association	Allen East, University of Oregon Medical School, Portland
Pacific Northwest Bird and Mammal Society	Earl J. Larrison, University of Washington, Seattle
Society of American Foresters, Northern California Section	Roy G. Wagner, 930 Phelan Building, San Francisco, California
Society for Experimental Biology and Medicine, Pacific Coast Branch	Dr. Rosalind Wulzen, Department of Zoology, Oregon State College
Western Interstate Snow Survey Conference, Pacific Division	R. A. Work, P.O. Box 1149, Medford, Oregon
Western Psychological Association	Othniel R. Chambers, Oregon State College
Western Society of Soil Science	W. P. Martin, University of Arizona

The program for the Corvallis meeting will be prepared during the month of May. Copies will be available at registration headquarters and will be mailed on request to members of participating societies. Each person planning to present a paper before one of the societies should communicate the title to the secretary or program chairman not later than April 15. In case the author is a member of a society which will not be participating in the Corvallis meeting, the title may be sent to the secretary of a closely related participating organization. Titles should be accompanied by abstracts of not over 200 words.

SCIENTIFIC NOTES AND NEWS

At the graduation ceremonies of the University of Buffalo, the chancellor's medal, awarded annually by the university council for outstanding achievement, was presented to Dr. George W. Thorn, Hersey professor of the theory and practice of physic in the Harvard Medical School and physician in chief of Peter Bent Brigham Hospital, Boston.

Dr. Arthur W. Bingham, chairman of the committee on maternal welfare of the Medical Society of New Jersey, has been presented by the Academy of Medicine of Northern New Jersey with the fourth Dr. Edward J. Ill award—a bronze plaque given to a North Jersey physician by the academy "at such time as it deems it wise, who merits it for extraordinary service as a physician and a citizen."

The American Association of Economic Entomologists has designated as an outstanding accomplishment of 1942 researches on the chemical properties and the insecticidal value of so-called summer-type oil sprays when used against the eggs of the codling moth, the Oriental fruit moth and bud moth conducted by Dr. P. J. Chapman, entomologist, and G. W. Pearce and Dr. A. W. Avens, chemists of the New York State Agricultural Experiment Station at Geneva. The work is part of a comprehensive research program.

The 1943 award in the annual nation-wide com-

petition sponsored by the Chicago Dental Society, for original research related to dental problems, was presented to Dr. Harry H. Shapiro and Dr. Raymond C. Truex, both assistant professors of anatomy at the College of Physicians and Surgeons, Columbia University. The prize-winning essay, entitled "The Temporomandibular Joint and Auditory Function," was read on February 22 at the annual meeting of the society in Chicago.

Nature reports that the medal of the British Institute of Metals has been awarded to Dr. Harold Moore for "outstanding services to non-ferrous metallurgy." Dr. Moore has been director of the British Non-Ferrous Metals Research Association since 1932. The medal, which is offered to the council of the institute by the Mond Nickel Company, Ltd., for award annually, is of platinum. Previous recipients have been Sir William Bragg, Sir Harold Carpenter, Dr. Paul Merica, Dr. C. H. Desch and Sir W. Murray Morrison. It was presented to Dr. Moore at the annual general meeting held in London on March 3.

AT the one hundred and twenty-first annual commencement of the Philadelphia College of Pharmacy and Science on February 24 the degree of doctor of science was conferred on Dr. William A. Feirer, director of the medical research laboratories of Sharp and Dohme, Inc., and on Dr. Harriet L. Hartley, of the Department of Public Health of the City of Philadelphia.

THE doctorate of science of Rollins College was conferred at the Founders' Day convocation exercises on George Howard Opdyke, of Hartford, Conn., mining engineer and petroleum geologist.

DR. H. JUSTIN RODDY, since 1926 professor of geology and executive curator of the Museum of Franklin and Marshall College, has been appointed professor and curator emeritus.

ACCORDING to *Nature*, the Committee of the Athenaeum, London, has elected the following, under the provisions of Rule II of the club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature or the arts, or for their public services: Professor Emile Cammaerts, professor of Belgian studies and institutions in the University of London; Admiral Sir Andrew Cunningham and Professor W. N. Haworth, professor of chemistry in the University of Birmingham.

DR. EUGENE MARKLEY LANDIS, professor of internal medicine at the University of Virginia, Charlottesville, has been appointed, effective on July 1, George Higginson professor of physiology at the Harvard Medical School, Boston, to succeed Dr. Walter B. Cannon, who recently retired.

DR. THOMAS BIGELOW CRUMPLER has been appointed head of the department of chemistry in the College of Arts and Sciences of Tulane University. He has been on the teaching staff at Tulane since 1937. Dr. Worden Waring has been appointed to an assistant professorship and Dr. Walter James Horton, Dr. Kurt Kraus and Dr. Billie Shive have been appointed instructors.

DR. ERNEST GARDNER, instructor in anatomy at Stanford University, has been appointed assistant professor of anatomy at the School of Medicine of the University of Southern California. Dr. Arnold Lazarow, formerly of the department of anatomy of the University of Chicago, is now research assistant in the department of anatomy of the University of Southern California.

DR. JOHN ALFRED RYLE, regius professor of physic at the University of Cambridge and physician extraordinary to the King of England, has been elected professor of social medicine at the University of Oxford.

DR. KENNETH A. BARTLETT, acting director of the Puerto Rico Federal Experiment Station since November, 1941, has been appointed director.

R. E. ZIMMERMAN, vice-president of the U. S. Steel Corporation, has been elected a member of the Board of Trustees of Franklin and Marshall College.

DR. LEWIS HILL WEED, director of the School of Medicine of the Johns Hopkins University, has been made chairman of the Medical and Health Advisory Committee of the American Red Cross. Dr. Weed has been chairman of the Division of Medical Sciences of the National Research Council since 1939.

DR. A. C. DAHLBERG, head of the dairy division of the New York State Experiment Station at Geneva, has been granted leave of absence by Cornell University in order to carry out a special mission in Central America and the northern part of South America for the U. S. Department of Agriculture and the Office of the Counsellor on Inter-American Affairs of the State Department. He will make available to Latin America the knowledge and experience available in this country on milk processing and dairy manufactures. His work will consist of surveys of the dairy industries of the countries he visits and of counsel with government and educational officials, farmers and dairy plant operators as an aid to stimulating milk production, increasing dairy manufactures and improving dairy practices. Dr. R. E. Hodgson, formerly of the Washington State College and now with

the U. S. Department of Agriculture, is accompanying Dr. Dahlberg. Most of the travel will be by plane.

THE nineteenth Ludvig Hektoen Lecture of the Frank Billings Foundation will be delivered by Dr. Lloyd F. Craver, New York, on March 26, under the auspices of the Institute of Medicine of Chicago. The subject of the lecture will be "The Diagnostic Problems of Early Cancer."

DR. ALFRED BLALOCK, professor of surgery at the Johns Hopkins University School of Medicine and director of the department of surgery at the Johns Hopkins Hospital, will give on March 11 the tenth E. Starr Judd Lecture at the University of Minnesota Medical School. He will speak on traumatic shock with particular reference to war injuries.

DR. RICHARD C. TOLMAN, professor of physical chemistry and mathematical physics at the California Institute of Technology and dean of the Graduate School, gave a lecture on "Physical Science and Philosophy" at the meeting on February 27 of the Philosophical Society of Washington.

PROFESSOR L. C. DUNN, of the department of zoology of Columbia University, gave an illustrated address on "Mistakes in Development in Mice and Men" before the Four-College Genetics Conference at Smith College on February 18. He also spoke to the classes in genetics at Amherst and Smith Colleges.

DR. LAURENCE H. SNYDER, chairman of the department of zoology and entomology of the Ohio State University, addressed the Louisiana State University chapter of Sigma Xi on February 9 on "Heredity and Modern Life." On February 10 he spoke at a meeting of Beta Tau Mu on "The Mutant Gene in Man."

PROFESSOR VERNON L. FRAMPTON, of the department of plant pathology at Cornell University, will deliver a series of lectures during March and April on "Colloid Chemistry" at the National University of Colombia at Bogota. During the past several years he has made a study of the chemistry of viruses causing plant diseases.

DR. MARGARET MEAD, assistant curator of ethnology of the American Museum of Natural History, visited Iowa State College from February 16 to 18. She gave a public lecture on "National Character and International Cooperation" and spoke to various seminars and other groups.

THE annual general meeting of the American Philosophical Society will be held on April 22, 23 and 24, beginning at 10 A.M., on Thursday, April 22. The morning, afternoon and evening sessions on Thursday, April 22, will be devoted to a celebration of the two hundredth anniversary of the birth of Thomas Jefferson. Carl Becker will deliver the Penrose Memorial Lecture on Thursday evening, April 22, on Jefferson's political philosophy with especial reference to the present. On Friday evening, April 23, Fiske Kimball will speak on "Jefferson and the Fine Arts." This will be followed by a musical program consisting of selections favored by Jefferson. On Saturday afternoon, April 24, at 2 o'clock there will be an illustrated lecture on "Historic Sites of Old Philadelphia," followed by visits to principal points of interest. The annual dinner on Saturday evening, at the Bellevue-Stratford Hotel, will commemorate the two hundredth anniversary of the proposal by Benjamin Franklin for forming the American Philosophical Society for promoting useful knowledge among the British Plantations in America. The Franklin Medal Lecture will be given on this occasion by Carl Van Doren on "The Beginnings of the American Philosophical Society." The sessions on Friday afternoon and Saturday morning will consist of papers by members and invited guests on various subjects. The annual executive session and election of officers and members will be held on Friday morning, April 23, at 9:30 o'clock.

THE cancellation of the annual meeting of the American Statistical Association in 1942 made it impossible to effect a change of officers by means of the customary election by the membership of the association. At its first meeting in 1943 the board of directors of the association accepted the resignations of the 1942 officers and appointed to the vacant offices the candidates proposed by the nominating committee. The officers of the association for 1943 are: E. A. Goldenweiser, *President;* C. I. Bliss, William G. Cochran, Roy L. Gillett, A. Ford Hinrichs, Walter Mitchell, Jr., Frank M. Surface, Donald B. Woodward and Theodore O. Yntema, *Vice-presidents;* R. L. Funkhouser, *Secretary* and *Treasurer*. Henry B. Arthur, Theodore H. Brown, Simon Kuznets and Alfred J. Lotka were appointed members of the board of directors.

DR. E. BRAUN-MENENDEZ, *Secretary,* and Dr. B. A. Houssay, *President,* of the third Pan American Congress of Endocrinology, have written as follows to Dr. Robert A. Lambert, associate director of the Rockefeller Institute: "This is to let you know that the Executive Committee of the Third Pan-American Congress of Endocrinology has decided to postpone *sine die* the realization of this congress. We wished to give the congress a real importance, but the absence of the lecturers appointed and of many other outstanding scientists would diminish the rank and dignity we think it should have."

THE three hundred and ninety-fifth meeting of the American Mathematical Society will be held at Hunter College on Friday and Saturday, April 23 and 24.

Sessions will begin on Friday morning and continue until noon on Saturday. The following addresses will be given by invitation of the program committee: "Spectral Theory," by Professor Nelson Dunford, of Yale University, on Friday afternoon; and "Absolutely Convergent Trigonometric Sums," by Professor R. H. Cameron, of the Massachusetts Institute of Technology, on Saturday morning.

DISCUSSION

THE TRIPLE POINT OF WATER

IN a survey of ten current text-books on physical chemistry, it was found that in only one of the eight which gave data on the triple point of water was the correct value for the temperature given. The usual value given is +.0075° C, which is that in the International Critical Tables.[1] This is actually the difference between the triple point temperature and the temperature at which ice and pure water are in equilibrium under one atmosphere total pressure. More recently this difference in temperature has been established experimentally[2,3] as 0.0074° C, and it can be calculated from the Clausius-Clapeyron equation of thermodynamics.[3,4] But the equilibrium temperature of ice and pure water at one atmosphere pressure is not zero degrees Centigrade.

In 1927, at the international Seventh General Conference of Weights and Measures, it was agreed that 0° Centigrade be defined as the temperature at which ice and air-saturated water are in equilibrium at one atmosphere total pressure.[5] Saturation of water with air lowers the equilibrium temperature by 0.0024° C.[2,3,4] The total difference in temperature between this as 0° C (on the International Scale defined at this conference) and the triple point is then .0024+.0074, and the triple point temperature is +0.0098° C (International).[6]

The vapor pressure of the liquid is usually defined as the pressure exerted by the pure vapor in equilibrium with pure liquid when the liquid is under no pressure except that of its own vapor; a similar definition is given for the vapor pressure of the solid. At the triple point, the vapor pressures of liquid and of solid are identical, but they decrease at different rates as the temperature is decreased. Therefore they are not identical at a temperature of 0° C, as most tables imply.[7] Usually, in calculating the vapor pressure of the solid, it is equated to that of the liquid at 0° C, instead of at the triple point.[8,9] There are thus inconsistencies in the values given for the vapor pressures of solid and of liquid near 0° C. The differences are small but appreciable.

The pressure exerted by the vapor in equilibrium with the liquid under various conditions not only changes with temperature, but also changes slightly if an excess pressure is exerted on the liquid phase, and if substances are dissolved in the liquid. The pressure exerted by the vapor in equilibrium with the solid behaves similarly. Liquid and solid water may exist in equilibrium, with equal but varying vapor pressures over a range of conditions, if these conditions are properly varied.

In addition to the triple point, two other equilibria are of interest. Pure liquid and solid are in equilibrium under one atmosphere total pressure at +.0024° C, and air-saturated liquid and solid are in equilibrium under one atmosphere total pressure at 0° C. The vapor pressure will be different in each of these three equilibrium states. The triple point pressure is the vapor pressure of liquid water or of ice (under only its own vapor pressure) at the triple point temperature. The difference between this and the vapor pressure in these other two states may be calculated by considering the variation as made up of the sum of three separate effects.

First, as noted above, the vapor pressures of solid and liquid decrease with a decrease in the temperature. Second, the vapor pressure of a liquid or solid (a condensed phase) is increased if a pressure is exerted on the condensed phase alone and not on the vapor. For example, if air pressure is exerted on a condensed phase, the vapor is not itself compressed since it can mingle freely with the air. This gives an excess pressure on the condensed phase. Third, the dissolving of air in the liquid lowers the vapor pressure of the liquid. We may assume air is insoluble in ice, or at worst that its solubility is so small as to have a negligible effect on the vapor pressure. The first and third effects tend to cancel the second, in our particular examples.

1 "International Critical Tables," Vol. IV, p. 11. McGraw-Hill, New York, 1928.

2 H. Moser, *Ann. der Physik,* (5), 1: 341–360, 1929; quoted in references 3 and 4.

3 J. A. Beattie, T. C. Huang and M. Benedict, *Proc. Amer. Acad. Arts and Sciences,* 72: 137–155, 1938.

4 N. E. Dorsey, "Properties of Ordinary Water-Substance," p. 604. Reinhold Publishing Corporation, New York, 1940.

5 G. K. Burgess, *Bur. Standards Jour. Res.,* 1: 635–640, 1928.

6 See also B. P. Veĭnberg, *Jour. Exptl. Theoret. Phys.* (U.S.S.R.), 9: 106–113, 1939, quoted in *Chemical Abstracts,* 33: 7655, 1939; he selects +0.0099° C as the best value.

7 *E.g.,* "International Critical Tables," Vol. III, p. 211.

8 E. W. Washburn, *Monthly Weather Review,* 52: 488–490, 1924; these calculations were made for, and are incorporated in, reference 7.

9 J. E. Goff, *Heating, Piping and Air Conditioning,* 14: 121–124, 1942. Dr. Goff has recently informed me that this correction was allowed for, although not explicitly stated in his paper.

The changes can be calculated quantitatively from thermodynamic equations, and the values found show that the vapor pressure for the equilibrium system at +.0024° C is 0.0012 mm higher than that at the triple point, and at the 0° equilibrium it is 0.0003 mm higher. For most practical purposes these changes are negligible, and the vapor pressure in any of these three states may be taken as 4.579 mm[7] or 4.581 mm.[10] A recent experimental determination has given the triple point pressure as 4.5867 mm;[11] this is not consistent with other values accepted at present for the vapor pressure of liquid water at temperatures near the triple point.

SUMMARY

(1) A common error in text-books on physical chemistry is pointed out. It is hoped that the correct value for the triple point temperature, +.0098° C, will be given in new books and in succeeding editions of the books surveyed above.

(2) Inconsistencies in the vapor pressure values for ice and for liquid water near 0° C are pointed out.

(3) The equilibrium vapor pressures for ice and liquid water under two different sets of equilibrium conditions are compared with the triple point pressure.

WORDEN WARING

TULANE UNIVERSITY

PALEOBOTANY IN INDIA

I HAVE just received from Professor Sahni of the University of Lucknow, India, a Progress Report on Paleobotany in India, at the head of which appears the following statement:

"We mourn the death of Albert Charles Seward (April 11, 1941). Doyen of Paleobotanists, whose noble personality, no less than his vast learning, was a fountainhead of inspiration to the Indian school of paleobotany."

Those of us who knew Sir Albert Seward as Master of Downing College, Cambridge, had long marvelled at his ability to carry on administrative and teaching work, along with research in paleobotany, and had noted his power of inspiring and fostering research among those who were so fortunate as to come under his direction. But at the present time, we are particularly concerned to note what he was able to do for India; mainly, it appears through the influence of his ardent disciple Sahni. With this source of inspiration, a school of Indian paleobotanists, centering in Lucknow, has developed and for many years their writings have brought to us new information concerning the fossil flora of India. Sahni, in recognition of his work, has been elected a Fellow of the Royal Society.

A paper by Sahni, which accompanies the Report, has to do with the beautifully preserved petrified remains of *Azolla,* showing all the minute details of structure. "The first and most striking fact concerning this specimen is the great perfection in which it is preserved. This helps us to see that in this early Tertiary *Azolla,* which is definitely the oldest known species of the genus, some of the most intimate details of the structure, and the way in which the massulae become anchored to the megaspore, are identical with those found in modern species. Considering that this plant lived about 60–70 million years ago it affords an impressive example of the persistence through the ages of a highly specialized type of behavior during the reproductive phase of the life-history of a genus."

The Oriental mind, for ages developing according to what seemed to be its peculiar genius, now shows its ability to take on the qualities of western culture, for good and for evil. It appears that scientific men such as Seward may promote the good influences, and cause the oriental workers to discover and develop their innate abilities. In such ways scientific research may serve the cause of civilization.

T. D. A. COCKERELL

CITRUS EXPERIMENT STATION,
RIVERSIDE, CALIFORNIA,

SCIENTIFIC BOOKS

CYTOPLASM OF THE PLANT CELL

The Cytoplasm of the Plant Cell. By A. GUILLIERMOND. Authorized translation from the unpublished French manuscript by Lenette R. Atkinson. Foreword by Professor William Seifriz. Waltham, Mass.: the Chronica Botanica Company. New York City: G. E. Stechert and Company. 247 pp. 152 figs. 1941. $4.75.

THIS is Volume VI in a new series of plant science books edited by Dr. F. Verdoorn. It is fortunate that the war has not prevented its translation by Mrs. Atkinson and publication in its present form, for it is a critical survey of all that has been done with regard to chondriosomes, vacuoles and various other structures in the cytoplasm of plant cells, by one who has made many of the most important contributions in this field.

One of the difficulties in the study of protoplasm is that it is usually divided into such small compartments, the cells, which are sensitive even to minor

[10] N. S. Osborne and C. H. Meyers, *Bur. Standards Jour. Res.*, 13: 1–20, 1934.

[11] K. Prytz, *Kgl. Danske Videnskab. Selskab. Math.-fys. Medd.*, 11: 7–46, 1931; quoted in *Chemical Abstracts*, 26: 627, 1932, and in reference 4 pages 563 and 575.

manipulation and *intra vitam* stains. Another is that in order to study protoplasmic structures they must usually be subjected to some stain, even if they are not killed, and the mere process of mounting for microscopic examination alters the oxygen supply and various other conditions. Guilliermond is fully conscious of all this, and his interpretations always allow for the possibility of some slight change from the healthy living condition even under the most careful treatment. In the twenty chapters of this volume his critical faculty is always on the alert to point out that the obvious interpretation is not necessarily the correct one or the only one. The general result is a solid body of well-documented material and conclusions, which will be of much value to all who are interested in the experimental study of protoplasm and the structures contained in the cytoplasm of plant cells.

The introductory chapters deal with the physical and chemical constitution of protoplasm, in which it is pointed out, for instance, that the viscosity ranges from 3 times to 10,000 times that of water and any isolated bit of cytoplasm forms a membrane about itself according to the law that molecules which lower the surface tension tend to accumulate in the peripheral layer. Much use is made of basic vital stains, such as Nile blue, cresyl blue and neutral red, while chrysoidine, probably because it is readily dissolved in lipides, stains clearly both cytoplasm and nucleus in cells which still show cytoplasmic streaming. But if growth is to continue, the vital dye is first accumulated in the vacuoles. In a chapter on the physical chemistry of protoplasm, microdissection and the coacervates of Bungenberg de Jong are among the topics considered.

In the chapter on plastids and the grana which are seen in some types of plastids, while no final opinion regarding their structurue is reached, plastids are regarded as probably composed of small lipide discs containing cholorophyll and embedded in a hydrophilic stroma. Five chapters are devoted to the chondriosomes and their relation to plastids. The duality of the chondriome is recognized and the author concludes on good grounds that plastids and chondriosomes are two categories of organelles which are permanently found in every cell of green plants, both showing all the characteristics of the chondriosomes in animal cells. The fact that the chondriosomes undergo vesiculation under some conditions leads to the conclusion that they also are coacervates.

Other chapters are concerned with the vacuoles, their vital staining, origin and development; and their transformations are fully illustrated in flowering plants, fungi and algae. They arise *de novo* in the cell and are believed to form through the separation from the cytoplasm of colloids having a stronger capacity for taking up water. The canaliculi of young plant cells are transformed into vacuoles, but a consideration of the evidence leads to the conclusion that there is no Golgi apparatus in plant cells.

This book should stimulate the study of the extreme complexity in morphological constitution of the cytoplasm, a colloidal system in which the chondriosomes, plastids and vacuoles constitute distinct phases. It adheres rather closely to the plant cell, but after all, that was the aim of the book.

One may agree with Dr. Seifriz, who has written the foreword, in being impressed with the thoroughness and the condensation with which the book has been written. The index of authors and of plant and animal names hardly compensates for the lack of any index of topics, and the frequent lack of dates in references to authors' papers will make some of them difficult to identify.

R. Ruggles Gates

Woods Hole, Mass.

SOCIETIES AND MEETINGS

THE AMERICAN SOCIETY OF TROPICAL MEDICINE

The American Society of Tropical Medicine, meeting conjointly with the Southern Medical Association, the National Malaria Society and the American Academy of Tropical Medicine, held its thirty-eighth annual meeting in Richmond, Virginia, on November 10, 11 and 12, 1942.

One of the outstanding features of the scientific session was the seventh Charles Franklin Craig lecture on tropical medicine, entitled, "The Importance of Tropical Medicine in the Armed Forces," by Rear Admiral Ross T. McIntire, U. S. Navy, Office of the Surgeon General, Washington, D. C.

A second highlight of the meeting was a symposium on "Tropical Medicine and the Medical School Curriculum," at which Dr. H. E. Meleney of New York presided. Dr. Paul Russell, Lieutenant Colonel, Washington, D. C., discussed the "Military Need," and Dr. Jean A. Curran, Brooklyn, N. Y., discussed "Finding a Place in the Medical Curriculum." In the absence of Commander M. E. Lapham, Washington, D. C., Dr. Meleney discussed the "Civilian Needs," as well as his own contribution, "Recent Progress." This symposium stressed the fact that there is a definite need for tropical medicine to-day in our medical school curriculum. A two-hour session was devoted to discussing this subject with fifteen

members of the Army, Navy and teaching profession participating, so that each group could learn the needs and difficulties of the other.

There was a record attendance at the annual luncheon of the society. The president, Dr. E. C. Faust, New Orleans, La., gave his presidential address on "Horizons of American Tropical Medicine." The society, for the first time in its history, honored individuals outside of the United States. The Walter Reed Medals of the society were given to two individuals from South and Central American countries. The first was presented to the Brazilian Government through its Minister of Education and Public Health, Dr. Gustavo Capanema, for outstanding work in eradicating *Anopheles gambiae* from Brazil. In the absence of Dr. Capanema, Dr. Mario Kroeff, director of National Council Research, received the award. The second medal was awarded to Dr. Carlos J. Finlay (posthumously) for pioneer work in yellow fever. Due to the illness of Dr. Finlay's son, Dr. Carlos E. Finlay, the medal was received for him by Dr. Domingo Ramos, director of the Finlay Institute, Havana, Cuba.

A round-table discussion entitled, "Malaria Therapy During the Present Emergency," closed the scientific session of the society. Dr. Herbert C. Clark, of Panama, presided, with Lieutenant Commander C. M. Wassell, Hollywood, California, and Dr. R. B. Watson, Memphis, Tennessee, participating. Dr. Clark discussed primarily the efficiency of totaquine as compared with quinine.

The American Academy of Tropical Medicine held its annual dinner, with Colonel R. P. Strong, of Washington, serving as toastmaster. Dr. W. C. Clark delivered his presidential address entitled "Some Impressions of Medical Practice in the Tropics."

The hospitality group met informally in the Jefferson Room of the Jefferson Hotel upon adjournment of the afternoon scientific sessions. In addition to the closer relationship between members and their guests, these meetings provided opportunities for brief discussions on currently vital topics. The first, by Dr. R. E. Dyer, was entitled "The Present Status of Typhus Vaccination." At the second gathering, Colonel George Lull, head of personnel in the Medical Division of the Army, discussed some of the problems associated with his office. These gatherings were again well attended and thoroughly enjoyed by the membership.

Joseph S. D'Antoni,
Secretary-Treasurer

TENNESSEE ACADEMY OF SCIENCE

The fifty-first meeting of the Tennessee Academy of Science was held at Vanderbilt University, Nashville, on November 27 and 28. A general session of the academy was held on Friday morning, November 27, with sectional meetings in mathematics, chemistry, geology and botany during the afternoon. A special session, new to the academy meetings, was held on Saturday, November 28. This new session was composed of a symposium on the teaching of the sciences under the chairmanship of Dr. A. J. Sharp, Department of Botany, University of Tennessee, and a Junior Science meeting with exhibits and demonstrations from the schools of central Tennessee. The Junior Science session was directed by Dr. Frances R. Bottum, of George Peabody College for Teachers, Nashville. It has been proposed that a junior section of the academy be formed, extending interest in the sciences in the schools, and Edwin D. Schreiber, of the Tennessee Industrial School, was chosen as chairman of this section.

At the academy dinner on November 27, Dr. D. M. Brown, professor of biology, East Tennessee State Teachers College, presented an address as the retiring president. A word of welcome was extended to the academy by Dr. Philip G. Davidson, dean of the Graduate School, Vanderbilt University.

The new officers of the academy for 1943 are Dr. C. S. Shoup, associate professor of biology, Vanderbilt University, *President,* and Dr. Edward McCrady, Jr., professor of biology, University of the South, Sewanee, Tenn., *Vice-president*. Dr. Kendell E. Born, Tennessee Division of Geology, Nashville, was reelected *Secretary-Treasurer,* and Dr. J. M. Shaver, of George Peabody College, Nashville, was reelected as *Editor* of the *Journal of the Tennessee Academy of Science*.

C. S. Shoup,
President

REPORTS

THE WAR STATUS OF AUSTRALIAN SCIENCE[1]

During the past twelve months the problems involved in the rapid expansion of Australian war industry have become more acute, but paralleling the growing unity and determination of the Australian people to defeat the fascists, a number of steps forward in the use of science, for which our association has long been pressing, have been taken. The conferences of Australian scientific workers called by the

[1] A report received by the American Association of Scientific Workers from the head of the Federal Council of the Australian Association of Scientific Workers.

Australian Association of Scientific Workers in the various states of the Commonwealth during the early part of 1942 did, we feel, play an important part in hastening some of these necessary and often long overdue steps. The initiative of scientific workers themselves has greatly assisted in improving the situation.

At the beginning of 1942 the Commonwealth Government appointed a commission of two energetic and capable scientific men (Professor E. Ashby and Dr. J. Vernon) to survey and report on the use being made of Australia's scientific resources in meeting and anticipating war-time problems. Their report revealed serious gaps between the needs of industry and the full use of available scientific knowledge, personnel and equipment.

One of their recommendations which has recently been acted upon is the setting up of an independent, compact and flexible Scientific Liaison Bureau which is charged with the wide responsibility of bridging the gaps between technical problems in the Services, government departments and war industries, and scientific men who can tackle the problems. The bureau is to direct scientific problems to the appropriate laboratory and should be able to advise scientific men as to the most useful contribution they could make to Australia's war needs.

Since early in 1942 there has been a central scientific manpower authority which attempts to allocate the available people to the positions needing them, with proper regard to the priority of important work. It appears likely that the most effective placement of available personnel has been reasonably well attained among physicists, but the same can hardly be said yet of chemists and biologists, though the position is far less chaotic than it was a year ago.

The government has recently introduced an entirely new policy in the training of students in "reserved" faculties in the universities. Students were admitted on a merit basis at the beginning of 1942, but, owing to the financial difficulties facing the majority of promising school pupils, the supply of good students was far short of the needs of the country. As from the beginning of 1943 the government will provide a reasonably adequate living allowance, plus remission of fees, to all students needing such assistance. With admission to the universities established on a merit basis, and with the universities actually inviting promising school pupils to come up, it seems certain that an important step has been taken towards getting the large numbers of graduates of high quality so urgently needed.

There is an acute shortage of physicists in Australia at the present time and means are being explored of ensuring that greater numbers of suitable students are trained. Some use has been made by the services in technical work (*e.g.*, radio) of graduates from other fields of science (*e.g.*, biology), but this use has not been as extensive as in England.

The conferences on "Science in the War Effort" which were convened by our association have led to the setting up, on the initiative of the laboratory personnel concerned, of panels in some sections of industry (*e.g.*, the paint industry). The object of these panels is the pooling and sharing, on a rational basis, of technical knowledge and investigatory work. Such panels are composed solely of technical men in industry and they give promise of being able, in some instances to reduce the hampering effects of trade secrets and of rivalry between firms.

The recent setting up of a food council to plan and direct the country's food production, at a time when the situation was becoming serious, owes something to representations arising from our conferences. At first the food council had insufficient scientific personnel and has not, even yet, sufficiently wide powers.

The association has always recognized that the inadequate salaries and unsatisfactory conditions of work sometimes found among the scientific staffs of smaller firms, particularly among chemists, is not only unwelcome to those immediately concerned and to the scientific profession, but has a bad effect on the application of science to the needs of society and to the war effort. In Australia, one way of remedying such conditions is through the arbitration courts or their conciliation officers. The Australian Association of Scientific Workers is, therefore, considering the question of taking a decision among its members as to the desirability of registering the association with the arbitration court. It appears that many members favor such a step. During the early years of its growth, since its inception in 1939, the association has not done a great deal directly to safeguard and improve the status of its members and it is thought that registration would enable more to be done in that direction.

The Australian Association of Scientific Workers is most anxious to maintain close touch with the Associations of Scientific Workers in Great Britain, the United States and New Zealand, and with the scientific bodies in the Soviet Union. It is felt that facilities should be provided for the free interchange between Allied countries of scientific information needed in war work. To this end, representations have recently been made to the Commonwealth Government asking that scientific liaison services between Australia and both the United States and the Soviet Union should be extended and improved.

For the Federal Council, Australian Association of Scientific Workers,

F. W. WOOD, *Honorary Secretary*

SPECIAL ARTICLES

MACROMOLECULAR COMPONENTS OF NORMAL EMBRYONIC AND ADULT BRAIN TISSUE[1]

Ultracentrifugal studies on plant[2] and animal tissues[3] have resulted in the demonstration in healthy organisms of constituents with high sedimentation constants. Recently, a material with a sedimentation constant of $S_{20} = 73.8 \times 10^{-13}$ has been obtained from extracts of chick embryo body tissue, and analyses have shown it to be a lipoprotein complex containing nucleic acid of the ribose type.[4] The frequency with which these components have been encountered and the high concentrations of them occasionally observed indicate not only a wide distribution but also a role of importance in the physiological processes of healthy tissues. In the work described here the question of distribution has been investigated further in studies on brain tissues from man and certain animals.

The studies were made on the whole brain tissue of man, the rabbit and the chick. Both embryonic and adult tissues were examined by procedures similar to those used in isolation of the normal component of the chick embryo body.[4] Fresh tissue was chilled and quickly ground either with sand in a Ten Broeck grinder or in the Waring Blendor. The mince was extracted in 20 per cent. suspension in distilled water for 48 hours at 5 to 8° C. After clarification with the angle centrifuge, the extract was filtered with celite and subjected to 1 or 2 cycles of ultracentrifugation at 67,000 g for 30 minutes. The resulting pellets were dissolved and stored in distilled water.

Two human embryos were studied. The brain from one of these, crown-rump measurement 16.5 cm, weighed 41 gm. From the extract of the cerebral tissue clear gel-like pellets were obtained representing 0.17 mg of nitrogen per gram of initial brain tissue. Solutions of the pellets in concentrations of 0.45 to 0.55 mg N per cc examined in the analytical ultracentrifuge showed sharp sedimenting boundaries indicative of considerable homogeneity. No light-absorbing material was seen above the boundary but beneath it there was present some material which sedimented more quickly than the component giving the sharp boundary. The sedimentation velocity in water was 70.8×10^{-13}. A similar component seen in the second embryo of about the same age gave a sedimentation velocity of 67.5×10^{-13}. Partial elementary analysis showed a composition of N, 12.7; C, 51.4; and P, 2.81 per cent. The density by pyknometer measurement was 1.42. The Millon and biuret tests were positive, and the glyoxylic acid test was weakly positive after 20 minutes. Bial's test following hydrolysis was negative. The Feulgen test was positive and so, too, was the diphenylamine reaction. These results indicate a material essentially protein in nature, possibly associated with a small quantity of fat and containing nucleic acid of the desoxypentose type.

Similar experiments with 4 batches of brain from chick embryos of 14 to 20 days incubation resulted in the purification of a component showing very sharp boundaries with a sedimentation velocity in water of 67.5×10^{-13}. The sedimentation constant in 0.005 M borate buffer, pH 7.2, was 75.2×10^{-13}. The constitution of this component was wholly different from that of human embryo brain but somewhat similar, though not identical, to the chick embryo body component.[4] The carbon content was 50.9, nitrogen 11.3 and phosphorus 2.9 per cent. Bial's test in this instance was strongly positive and the diphenylamine test dubiously positive, indicating a further resemblance of this brain component to that of the body tissue in the presence of ribonucleic acid. The yield was 0.1 mg N per gram of brain.

Experiments with the brain of rabbit embryos yielded a constituent giving good sedimentation diagrams and a sedimentation velocity in water of 68.9×10^{-13}.

Examinations of adult brain from man, chick and rabbit resulted in all cases in preparations showing very diffuse sedimentation diagrams under the same ultracentrifugal conditions giving sharp boundaries with embryo material. The sedimentation velocity of the adult brain material was of the same magnitude as that from embryo tissue. This finding indicated great heterogeneity with respect to particle size. Another striking difference between the embryo and adult was the yield of product which was approximately 5 times greater for the embryo than for the adult. Electron micrographs of the materials from human and chick embryo brain showed rounded images approximately 18 mμ in diameter for both. The images appeared uniform in size and no internal structure was visible.

Thus far the components of normal tissues have been encountered chiefly as complicating factors in the purification of viruses such as those of certain plant diseases and the agent of equine encephalomyelitis.[5] Recent studies[6] on poliomyelitis have revealed in diseased cord and medulla of monkeys a

[1] This work was aided by the Dorothy Beard Research Fund and by a grant from Lederle Laboratories, Inc., Pearl River, N. Y.

[2] W. C. Price and R. W. G. Wyckoff, *Phytopathology*, 29: 83, 1939.

[3] R. W. Glaser and R. W. G. Wyckoff, *Proc. Soc. Exp. Biol. and Med.*, 37: 503, 1937.

[4] A. R. Taylor, D. G. Sharp, D. Beard and J. W. Beard, *Jour. Infect. Dis.*, 71: 110, 1942.

[5] A. R. Taylor, D. G. Sharp, D. Beard and J. W. Beard, *Jour. Infect. Dis.*, in press.

[6] H. S. Loring and C. E. Schwerdt, *Jour. Exp. Med.*, 75: 395, 1942.

material with a sedimentation constant of 62×10^{-13}, a value essentially the same as that obtained with normal brain tissue here. The components isolated in the present work exhibited evidence of high homogeneity in the analytical ultracentrifuge. Despite the similarity of the sedimentation velocity values, the various components, including the material of chick embryo body,[4] differed constitutionally, indicating not only species but organ variation. In addition there was variation associated with age. The results suggest that further study of the normal tissue components may be of significance not only in relation to physiological processes but possibly in the investigation of non-infectious pathological processes such as neoplasms. This is supported by the results of preliminary studies now being made in this laboratory with certain brain tumors of man.

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THE CONVERSION OF DESOXYCORTICOSTERONE TO PREGNANDIOL-3 (α), 20 (α)[1, 2]

THE conversion of desoxycorticosterone acetate to pregnandiol glucuronidate in a normal man was claimed by Cuyler, Ashley and Hamblen.[4] The evidence was based on two isolations of pregnandiol glucuronidate, one m.p. 240° C and the other m.p. 261° C. The melting points of both compounds were low as compared to the melting point for pregnandiol glucuronide (268–271° C) reported by Venning and Browne.[5] No evidence for the identity of the compounds was presented in addition to these melting point determinations. In a second communication Cuyler, Hirst, Powers and Hamblen[6] were unable to reproduce their original results. In the course of a study of the metabolism of desoxycorticosterone and other adrenal cortical steroids in the chimpanzee and human, we have demonstrated the conversion of desoxycorticosterone to pregnandiol-3 (α), 20 (α) in the ovariectomized chimpanzee.

A total of three grams of desoxycorticosterone acetate[3] was administered orally over a period of 15 days. The hormone was administered once daily in doses of 200 mg. Urine was collected for the 15-day period during hormone administration and for the following three days. A total of 14.9 liters of urine was collected. Fifteen cc of concentrated hydrochloric acid and 25 cc of carbon tetrachloride were added to each 100 cc of urine. Hydrolysis and extraction were carried out simultaneously for a period of 8 hours. The carbon tetrachloride was separated and an additional quantity of fresh carbon tetrachloride added and the extraction repeated. The material soluble in carbon tetrachloride was separated into two fractions by means of 10 per cent. sodium hydroxide; one, the fraction containing the neutral compounds, and the other the fraction containing the acidic and phenolic compounds. By means of the Girard-Sandulesco ketone reagent, trimethylacethydrazide ammonium chloride and succinic acid anhydride the total neutral compounds were separated into four fractions: the ketonic-hydroxy, ketonic-nonhydroxy, nonketonic hydroxy and nonketonic-nonhydroxy fractions.

The nonketonic-hydroxy compounds were further separated with digitonin into fractions containing the soluble and insoluble digitonides, respectively. A colorimetric assay of the former fraction indicated 455 mg pregnandiol equivalent.[7] It was adsorbed on a column (10×190 mm) of Brockmann's aluminum oxide from a solution of benzene. The column was eluted with progressively increasing concentrations of ethanol in benzene ranging from pure benzene to 16 per cent. ethanol in benzene. The fraction eluted by 1 per cent. ethanol in benzene yielded a crystalline material which assayed 125 mg of pregnandiol equivalent. The material after recrystalizing three times from aqueous ethanol yielded 45 mg of a compound which melted at 228–229° C.[8] A mixture of this compound with an authentic sample of pregnandiol-3 (α), 20 (α), m.p. 229–231° C, melted at 229–230° C. The diacetate melted at 175–176° C and when mixed with pregnandiol-3 (α), 20 (α) diacetate, m.p. 174–175° C, the mixture melted at 174–175° C.

After combining the mother liquors and rechromatagraphing the crude compounds an additional quantity of 34 mg of pregnandiol-3 (α), 20 (α) was isolated. Thus the total quantity of pregnandiol-3 (α), 20 (α) recovered from 3 grams of desoxycorticosterone acetate totaled 79 mg, indicating a conversion of 3 per cent. In a second experiment when 1.2 grams of desoxycorticosterone acetate was administered to the same ovariectomized chimpanzee, 12 mg of pregnandiol-3 (α), 20 (α) were recovered in the urine. This represented a conversion of 2 per cent.

[1] Supported in part by the Josiah Macy, Jr. Foundation. Accepted for publication in SCIENCE, November 14, 1942.

[2] From the Brush Foundation and Department of Biochemistry, Western Reserve University School of Medicine and the Department of Medicine, Lakeside Hospital, Cleveland, Ohio.

[3] The desoxycorticosterone acetate was kindly supplied by the Ciba Pharmaceutical Products Inc. under the trade name of Percorten.

[4] W. K. Cuyler, C. Ashley and E. C. Hamblen, *Endocrinology*, 27: 177, 1940.

[5] E. M. Venning and J. S. L. Browne, *Proc. Soc. Exp. Biol. and Med.*, 34: 792. 1936.

[6] W. K. Cuyler, D. V. Hirst, J. M. Powers and E. C. Hamblen, *Jour. Clin. Endocrinology*, 2: 373, 1942.

[7] N. B. Talbot, R. A. Berman, E. A. MacLocklan and J. K. Wolfe, *Jour. Clin. Endocrinology*, 1: 668, 1941.

[8] Melting points are uncorrected and were determined by means of the Fischer-Johns apparatus.

This conversion of desoxycorticosterone to pregnandiol-3 (α), 20 (α) is unique in the metabolism of the steroid hormones since it is the first instance of the replacement of an hydroxyl group by a hydrogen atom. Thus the primary alcohol group at C-21 in desoxycorticosterone is reduced to the corresponding methyl group in pregnandiol-3 (α), 20 (α).

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

DEVICE FOR THE PREPARATION AND TRANSFER OF OXYGEN-FREE SOLUTIONS[1]

A PROBLEM frequently encountered is the preparation of an air (oxygen)-free solution and its subsequent introduction into an experimental vessel. For example, in the course of spectrophotometric determinations involving solutions of respiratory enzymes and other proteins it is necessary to remove all traces of oxygen and then to transfer the solution to the cell

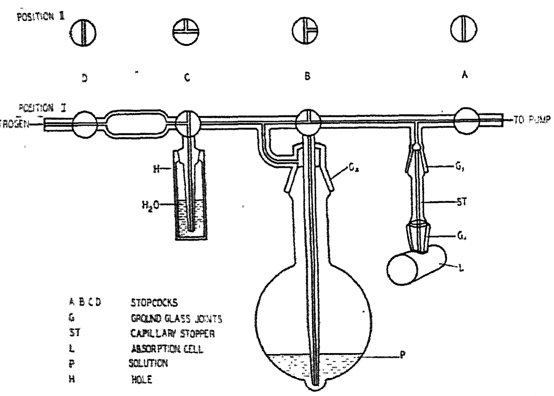

FIG. 1.

in which light absorption is to be measured. Another case is the introduction of air-free solution into a reaction cell for photochemical purposes, particularly when the analytical procedure involves spectrophotometry or colorimetry.

A very simple and widely used procedure which involves passing nitrogen through the solution is of limited usefulness. Thus in the case of protein solutions the customary method may lead to extensive foaming which results in loss of material and in denaturation of the protein. In all cases it is limited to solutions in which solvent and solutes are relatively non-volatile.

We present below a device which has been very useful in this laboratory and which seems to have general applicability. With the stopcocks A, B, C and D set as designated by "Position I," gaseous nitrogen is admitted at D and at the same time the other part of the system, including the absorption cell, is connected to a high vacuum pump for a few minutes. By gentle rotation of the flask the solution will be spread out and a very efficient removal of gas will take place. In order to transfer the oxygen-free solution to the cell L the stopcocks are adjusted as indicated by "Position II," where stopcock C should be operated last and rather gradually. With increasing nitrogen pressure the solution will be forced through the capillary and into the attached cell. The ground glass joint G_1 allows the detachment of the cell. The capillary stopper,[2] filled with solution, prevents the diffusion of air into the cell. In an alternative arrangement a stopcock is inserted in the capillary and closed at the conclusion of the transferring operation.

A modified procedure is employed in case the solution is volatile or has a volatile component. The flask is closed off by means of stopcocks B and C and its contents frozen by immersion of the flask in liquid air.[3] After temperature equilibrium is attained stopcock B is turned to Position I and the system evacuated, thus removing all non-condensable gases. Then, with stopcock B closed, the flask is heated to room temperature, whereby most of the dissolved air escapes into the vacuum above the solution. The process of alternate freezing, evacuating and thawing is repeated; it was found that three such steps sufficed to remove oxygen effectively from a 12 molar hydrochloric acid solution, the concentration of acid remaining unchanged within the accuracy of the analytical method employed (0.5 per cent.).

The method as described relies to some extent on the purity of the nitrogen used. However, one may employ commercial nitrogen and avoid contamination of the solution with oxygen if a surplus of the solution is available, for the top layer of the liquid will protect the portion which is to be transferred.

The authors wish to acknowledge their indebtedness to the Rockefeller Foundation for its support of the project in which this work developed.

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ROBERT L. PLATZMAN

[1] From the George Herbert Jones Chemical Laboratory of the University of Chicago, Chicago, Illinois.

[2] O. Warburg and E. Negelein, *Biochem. Zeitschr.*, 214: 64, 1929.

[3] A. Farkas and L. Farkas, *Trans. Far. Soc.*, 34: 1121, 1938.

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SCIENCE NEWS

Science Service, Washington, D. C.

BIOLOGY, THE SCIENCE OF PEACE

BIOLOGY, unlike physics and chemistry, has not been heavily drawn upon in the service of war, Dr. Edwin Grant Conklin, president of the American Philosophical Society and of Science Service, pointed out in an address on March 1 given before the Science Talent Institute, attended by the forty topflight high school Seniors, in Washington to compete for scholarship prizes in the Second Annual Science Talent Search.

Biology is the science of peace, Dr. Conklin emphasized; it is the science of life rather than of death. Biologists have been left at their normal posts, to teach medical students and to carry on research in agriculture, nutrition and public health.

Dr. Conklin pointed out that "Biology is in times of war less applied than these other subjects, but it is no less important. Nothing concerns man so much as understanding life—his own life and that of animals and plants. The great lesson of evolution is not that we are descended from monkeys (which we are not), but the fact that all life, that of plants, animals and men, is fundamentally alike."

The speaker warned his young hearers against the heresy, too prevalent in the period between the two World Wars, that the chief aim of science is material success in war or in peace. He challenged them to produce from their ranks a new Darwin who will discover the unknown factors of evolution, a new Pasteur who will demonstrate the causes of cancer, a new Columbus of biology who will venture out on the dark unknown sea between the living and the non-living and find the connection between them.

VANADIUM IN ANCIENT OCEAN BEDS IN IDAHO AND WYOMING

DEVELOPMENT tunnels to tap a jackpot of the war metal, vanadium, are being driven into the canyon walls of Sublette ridge. This formation, running off the southeastern tip of Idaho into Wyoming, is the site of old ocean beds which it is estimated contain millions of tons of vanadium ore. From it comes the light gray metal used as a toughener for armor plate, guns, machine tools and other victory ingredients.

Discovered by the U. S. Geological Survey, the deposits will go far toward making the nation self-sufficient in this war necessity. Up to this time an important part of our vanadium came across submarine-infested sea routes from foreign mines, mainly in Peru. Utilization of the newly found deposits would free much needed shipping space.

More than two years ago phosphate miners in this region began to recover vanadium as a by-product without knowing of the richer beds which lay near-by. But about this time, W. W. Rubey, of the Geological Survey, searching for phosphate fertilizer, sent in some unimportant-appearing dark shales and mud-stones for analysis. Back came the report on vanadium—a much higher percentage than appeared in the phosphate rock itself.

Then came a tedious period of exploration and sampling. Along a gulch at the foot of Sublette ridge, the searchers came upon the long-abandoned diggings of an old fertilizer prospector. Here a vanadium-rich sample was found which led them to still others. Most of the better analyses seemed to come from one particular bed.

After Pearl Harbor the work was pushed with renewed vigor. Hundreds of old samples were reexamined. With this correlated data, Mr. Rubey again went into the field last spring to test his theory that a single workable vanadium bed of wide extent had been discovered.

Establishing a field laboratory, he took more samples and analyzed them on the spot. Engineers from the Bureau of Mines then came in to cooperate. Finally it was proved that the bed was vanadium-bearing nearly everywhere and its position was carefully mapped. The results were turned over to the Bureau of Mines, the War Production Board and the Metals Reserve Company for action. Secretary Ickes has banned speculative claim-staking to insure rigorous testing and proper public control of this important war project.

SOUTHERN PINE STUMP AND PINE OIL

PINE stump salvaging has become a profitable enterprise in southern states where reduction plants have been established to chew them up and extract their turpentine, resin and pine oil. The plants are working at full speed these days as the war activities use up their products as fast as they can turn them out.

Generally the stumps are left in the ground to rot if the land is to be used for another timber crop. They must be cleared if the land is to be used for farming. Leaving them in the ground or pulling and burning them wastes their valuable resinous and oil contents. Much experimental work has been done during the past two or three decades by the U. S. Department of Agriculture and by private companies interested in naval stores, to find a profitable method of extracting resinous contents for commercial purposes. Processes have now been simplified and a great expansion in the industry may be expected.

Before the stumps are processed they must be thoroughly dried. Usually they are left in the ground to dry. This may take several years. While drying important changes take place in the composition of their resinous contents. Then they are pulled with special machines, loaded on trucks and taken to the mill. They are washed free of all earth in long troughs through which they are dragged on an endless chain in a stream of running water.

The next step is their mastication. They are ground in drums with heavy cutting blades that crush, cut and chew them into small pieces. In another machine they are further shredded into tiny chips. What was once an ungainly stump is now a mass of very small pieces, and ready for the treatment necessary to extract the oil, turpentine and resin. The extraction is accomplished in large tanks, some of which will hold as much as 15 tons

of the chips. The tanks are sealed and the contents treated with a solvent—benzole, naphtha or other petroleum product—which is steam-heated and forced in under pressure. The solvent mixes with the tiny chips and takes up the resin, turpentine and oil in solution. When the process is completed the liquid is drawn off and the resin-free wood is used for fuel under the boilers of the plant.

The liquid solution is first cooled. A resinous pitch settles which is easily separated. It is sold to foundries where it is used as a core binder. The remaining liquid is separated by distillation. The petroleum solvent is evaporated off first, as it has the lowest boiling point. It is reused. The turpentine is evaporated off next, then the pine oil. The resin is left in the retort, from which it is drained as a heavy fluid that hardens as it cools.

Longleaf pine and slash pine stumps are used in these processes. There are some nine or ten well-equipped plants operated in the country. The uses of turpentine and resin are well known. Pine oil is used in the manufacture of textile sizes, disinfectants, liquid and industrial soaps, and in a variety of sprays. It is used also as a flotation agent in recovering metals in copper refining.

NUTRITIONAL STANDARDS

RECONSTRUCTION in the postwar world, and advances to new achievements in civilization and culture, will depend to a very considerable extent on a high nutritional standard—higher than was ever known in prewar ways, according to Dr. Frank G. Boudreau, executive director of the Milbank Memorial Fund, who spoke at the midwinter meeting of the American Philosophical Society.

The advantages of abundant nutrition over just-sufficient feeding have been repeatedly demonstrated, both in sociological field observations and in controlled experiments, Dr. Boudreau pointed out. Even with animals the results are beyond argument. Colonies of laboratory rats, descended from long lines of sleek and well-fed ancestors, immediately showed improvements in health, vigor and longevity when they were given extra feedings of vitamins and other health-making factors. As negative evidence, Dr. Boudreau cited the cultural stagnation of the late middle ages and early modern times, when famines occurred on the average of seven times in a century, keeping whole populations hungry as much as a tenth of the time.

If we are to move forward into the gleaming civilization that forward-looking statesmen see for us beyond the present smoky horizon, we shall have to see to it that the American people, to say nothing of the rest of the world, receive far better nutrition than the average American prewar diet represented. Prewar consumption, on the basis of careful studies by the Food and Nutrition Board of the National Research Council, showed some astonishing lacks, for a people who boasted themselves the best fed in the world. From the diet designated by the National Research Council studies as best adapted, the following deficiencies were noted: 59 per cent. in leafy green and yellow vegetables, of 45 per cent. in milk, 28 per cent. in citrus fruits and tomatoes, 25 per cent. in beans, peas, and nuts, 17 per cent. in eggs, 14 per cent. in tomatoes, 4 per cent. in meat, poultry, and fish, and 2 per cent. in flour and other cereals. There was an excess production of 8 per cent. in butter and other fats and of 15 per cent. in sugar.

To right this, even for the United States alone, will require a reorientation of our agriculture that is not much short of a revolution.

ITEMS

EVIDENCE that luminous hydrogen gas is streaming from a faint star known to astronomers as HD 242257 in the constellation of Auriga, the Charioteer, at the rate of 1,200,000 miles an hour, has been obtained by Dr. Paul W. Merrill, of the Mount Wilson Observatory. If the sun were expanding with the same speed it would swell to the size of the earth's orbit in three days. The evidence is based upon photographs of the spectrum of the star taken with the 100-inch reflecting telescope. Dr. Merrill suggests that possibly forces are at work in the atmosphere of the star similar in nature to those that cause sudden eruptions of vast clouds from the surface of our sun. "So far as I am aware, no other star except a nova is known to be surrounded by an atmospheric shell of hydrogen expanding at so tremendous a rate," said Dr. Merrill.

WAR plane output is being speeded by the production of aircraft parts by thousands of factories scattered throughout the country. These converted plants are assisted in their war work by the use of standard specifications distributed by the Society of Automotive Engineers. The specifications include precise engineering instructions covering processes and materials, types, qualities and tolerances. They have enabled widely separated plants to turn out standard aircraft parts which on the assembly line in the warplane factory are used in the assembling of the completed plane. Metallurgists and materials engineers representing the aircraft industries, and Army and Navy officials cooperated in writing the specifications. Some 283 specifications have been completed. Others are in preparation. Nearly half of those originally issued have been revised to meet newer aircraft specifications.

ABOUT 36,000 residents of Washington, D. C., most of them employees of the Federal Government, have been vaccinated against smallpox since last December, has been announced by the District of Columbia Health Department. About 10,000 of these vaccinations were given by physicians of the health department and the rest by the medical staffs of various Federal and District agencies. The outbreak of smallpox in near-by Pennsylvania stimulated the current vaccination drive, but Dr. George C. Ruhland, health officer of the District of Columbia, is still urging that all persons living there who have never been vaccinated should take this health protection immediately. The reason is that Washington is the crossroads of the world in war activities. People are coming not only from the entire nation but from all over the world, many of them from regions where vaccination against smallpox is not practiced, and this increases the danger to unvaccinated persons there. No case of smallpox has been reported in that city in the past 10 years.

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A RATIONALE FOR STUDIES IN THE CONTROL OF EPIDEMIC INFLUENZA[1]

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That a lectureship established to perpetuate the influence of an illustrious anatomist should risk contamination by the nebula of influenza is of itself sufficient evidence that he instilled a spirit of broadmindedness and extension into borderline fields. In the study of infectious diseases the usual emphasis is upon the body fluids, while too little attention is directed to the cellular disturbances. Or too little thought is given to interpretation of those disturbances when they are observed. It becomes increasingly apparent, with the viruses particularly, that typical pathological lesions represent injuries induced because of a preference of the invader for certain physiological conditions or because a cell type possesses attributes which selectively attract the infectious agent. The physiology of infection—its pathogenesis—reveals more and more clearly that the purpose of preventive measures is to prevent that union or to modify its effect. This is well illustrated in the problem of influenza.

The recognition that epidemic influenza is a virus disease has constituted a notable advance, but a clarification of all the problems involved has not been accomplished. In fact, there is still confusion in terminology and a diversity of opinion as to what should be included under the diagnosis of influenza. Some tend to include all unidentified respiratory dis-

[1] The Annual Clarence M. Jackson Lecture, sponsored by Phi Beta Pi Fraternity, University of Minnesota Medical School. Delivered October 21, 1942.

ease in the term, adding a greater load than even the much-abused influenza can rightfully bear. There are others who speak of pandemic influenza as something apart and continue to use it in the unjustified sense of severity rather than distribution. "Sporadic" influenza is employed carelessly despite the fact that the last ten years have yielded little evidence of sporadic distribution of the known viruses of influenza. In this discussion influenza will be considered an epidemic disease which occurs at frequent intervals in the same geographic areas, spreads rapidly, subsides promptly and varies remarkably in extent and severity in different years. An attempt will be made to interpret the problem of prevention in the light of evidence gleaned from studies with viruses which have been identified, utilizing this information to establish a rationale for the various approaches directed toward the protection of a susceptible population.

In the control of epidemic diseases chance observation and empirical analogy have been widely followed. The student of a disease, however, seeks by utilizing knowledge of the physiology of the infection to orient efforts toward the most effective site at which to interrupt the sequence of infection. In order to do so major attention must be given to the manner in which infection is induced and the mechanisms by which immunity is effected.

The Pathogenesis of Influenza

The reservoir of epidemic influenza is not established. There is, however, considerable evidence that it may be in circulation in some part of the world at all times. The possibility of carriers has not been eliminated. Nor has a reservoir for human infection similar to that of the lungworm and earthworm demonstrated by Shope in swine influenza been explored. It is clear, therefore, that until further information concerning this aspect is available we are forced to combat the disease as it erupts.

Influenza spreads through a population by the transfer of virus from the respiratory tract of the infected individual to that of a susceptible. In the majority of instances the process is a direct infection, although indirect transfer through contamination is obviously possible. There is little reason to consider the disease air-borne except when in crowded quarters the differentiation between direct transfer and impregnation of the air becomes academic. When virus of influenza gains entrance to the respiratory tract of the susceptible it selectively attacks and destroys the ciliated columnar epithelium. These cells are superficially situated, not intimately bathed in the fluids of the blood stream, and apparently protected to a great extent by their own mechanisms, such as mucous secretions and ciliary action. Following the necrosis of the attacked cells exudate is poured out and the supporting tissues give evidence of acute, edematous, inflammatory changes. These changes are essentially limited to the nose and the larger respiratory passages.

The pneumonia commonly seen in experimental animals is not a necessary accompaniment of the invasion. In fact, during the early passages in which the virus is becoming adapted to ferrets or mice, pulmonary lesions are not observed, although virus is abundantly present. And it is clear that in the human population pneumonia is present in only a minority of the patients. It seems probable that involvement of the pulmonary tissue is a phenomenon secondary to the destruction of bronchial epithelium in which interstitial swelling, peribronchial infiltration and the outpouring of serous fluid and mononuclear cells represent the major change. The necrotic process observed in the respiratory epithelium is not detected in the alveolar walls.

In the absence of invasion by way of the respiratory tract influenza virus does not produce the lesions. From the lungs of mice which have been given the virus intraperitoneally one can recover large amounts of virus without any evidence of pneumonia. When relatively immense doses of the virus are given by the abdominal route, however, the mice may develop fatal pulmonary disease. It seems likely that the result is due to an overflow of virus into the upper respiratory tract whence it proceeds to cause pulmonary disease by the usual sequence observed after the intranasal inoculation while virus present on the vascular side of the alveolar wall fails to produce disease by failing to reach the susceptible epithelium.

There is little evidence, despite the extensive constitutional symptoms, that influenza is a generalized infection. One might wonder whether the severe myalgias represent damage to the neuromuscular system. While the virus has been demonstrated in the blood of mice for short intervals and after special conditions of inoculation, it has not been recovered from the blood of patients. Furthermore, no significant pathological changes have been recognized in organs other than those of the respiratory tract. The conclusion appears justifiable, therefore, that influenza represents in its pathogenesis a specific injury inflicted by a virus of sharply selective affinities upon a specialized type of cell lining the respiratory tract and that to obtain resistance these cells representing the portal of entry must be afforded protection.

Protection may be conferred by procedures which prevent the virus from reaching the susceptible individual or by procedures which alter the reactivity of the individual so as to render him resistant to the

harmful effects of the infectious agent when it arrives. The latter is usually implied in the term, immunity.

IMMUNITY

What evidence is there that a state of immunity to influenza can be achieved? It has long been said that immunity to influenza is either short-lived or non-existent. It has even been stated that one attack renders an individual more susceptible to subsequent exposures. Statements based upon clinical criteria tend to be inaccurate because of insufficient observation or unwillingness to adopt even those diagnostic criteria which become apparent to the seasoned observer. Owing to the fact that until recently it had not been possible to consider the diagnosis etiologically it is obvious that the question can not be answered on the basis of previous epidemiological data. What appeared to be the same disease clinically or epidemiologically might prove to be entirely different immunologically. Nevertheless, it had been generally accepted that immunity to influenza does exist, that it lasts for a period of some months, at least, but rarely over a long period of years. The tendency for influenza to occur most frequently in children also suggests that resistance increases after that period. Moreover, there is ample evidence that every one exposed, even intimately, in the course of an epidemic does not take sick. The need for such data based upon etiological studies is evident and offers a fruitful field for extended investigation.

At present two distinct types of influenza virus can be identified. The first, originally described by Smith, Andrewes and Laidlaw and confirmed in our laboratory, has been called Type A. This virus has been found to be the causative agent in the outbreaks of 1932–33, 1934–35, 1936–37, 1938–39 and 1940–41. The other, Type B, isolated in 1940 in our laboratory and independently by Magill, was shown also to have been responsible for the wide-spread epidemic of 1936. The disease caused by them has been recognized only in epidemic forms. Each has been implicated in extremely mild and moderately severe epidemics. The two types of virus are similar in that they produce diseases in man and animals which are epidemiologically, clinically and pathologically similar. Magill and Kendall have observed individuals who in successive attacks of influenza had been infected with influenza A and influenza B, respectively. Immunologically, they are so different that infection with Type A virus does not elicit antibodies to Type B virus; immunity to one affords no resistance to the other; nor do serological reactions reveal any evidence of a basic relationship between the two. It is not improbable that still further immunological types will be detected. Until then it seems unwise to test the sales resistance of the physician by the use of terms of misleading accuracy, such as influenza Y.

Beyond the differences in types there is variation in strains of virus belonging to the same type. Some of these differ sharply from others and under specified conditions it can be demonstrated that resistance to one strain of Type A may not give complete protection against another. What role the differences play in epidemic recurrence is not yet established, but the lack of homogeneity observed among strains isolated during different epidemic years indicates that they may be of definite significance. In any case the distribution of multiple types and divergent strains constitutes an inherent difficulty in establishing immunity to the presently unpredictable recurrences of influenza. Fortunately, however, it appears that the basic pattern of pathogenesis and resistance is the same for all the variants so that, apart from their serological behavior, they can be considered as a pathogenic unit.

Most of the accurate information concerning immunity to influenza virus has been obtained from study of the experimental disease. In animals susceptible to the virus, immunity can be induced readily. Vaccination of mice by the intraperitoneal route results in the development of antibodies and immunity without producing infection; subcutaneous vaccination is ordinarily not as effective. The degree of immunity in mice is measured by the survival of the animals and the absence of pulmonary lesions. In the ferret, however, more rigid conditions can be imposed. In addition to the criteria applied to mice, the occurrence of fever, lassitude and nasal signs can be recorded. Vaccination of the ferret does not usually give complete resistance; intranasal test may cause fever and signs of nasal injury. Judging from survival and the absence of pulmonary lesions, however, the vaccinated ferret appears as resistant as vaccinated mice.

Recovery from even mild infection is accompanied by complete immunity. But this resistance wanes so that after a few months the previously infected ferret behaves like the one which had been vaccinated. Antibodies persist, but the respiratory epithelium destroyed by the primary infection has returned to anatomic normalcy and with that return has again become susceptible to infection. Immunity tests are followed by fever and the other milder features of the disease but pneumonia does not occur. Following the second infection the antibody titer rises to a much higher level than that attained as a result of the primary infection and the animal is once more immune.

It is of interest, however, to note that by repeated intranasal doses of small amounts of the infectious

agent at short intervals after an original mild disease it is possible to maintain a state of complete resistance in ferrets without significantly affecting the level of antibodies. There is evidence, moreover, to indicate that the normally susceptible epithelium itself has been modified so that as a result of repeated stimuli it has developed a functional resistance independent of antibodies in the circulating blood. These facts have been briefly recounted in order to furnish a background for the various directions which may be taken in attempting to prevent influenza in man.

ACTIVE IMMUNIZATION

Let us first consider the induction of specific immunity. Preventive specific immunity is related in most minds to the action of specific antibodies in the blood, actively acquired through vaccination, or through subclinical infection with a modified virus; passively conferred by the parenteral administration of antibodies. The thesis which I propose is this: In order to function most effectively specific antibodies must be available to prevent the virus from attacking the cells to which it is specifically attracted. When the agent must be transmitted by way of the blood to reach its site of localization, circulating antibodies can exert their greatest effect. When, however, the portal of entry is superficial and also constitutes the area of primary injury it is apparent that antibodies can prevent disease only if they are immediately present in that area.

It has been uniformly observed that a high percentage of patients who develop influenza have antibodies in the blood at the time of onset. Since in the majority of such instances the titers are relatively low it has been the tendency to conclude that resistance is proportionate to the antibody level. The experiments of Smorodintseff *et al.*, Burnet, and Stokes and Henle were based upon experimental infection of human subjects. They, too, state that a relationship between susceptibility and antibody titers exists. Since vaccination of human subjects with influenza virus in the active or inactive state is followed by a sharp increase in circulating antibodies it has been assumed that resistance might be increased proportionately. This is the basis on which most vaccinating efforts have been projected but concerning which little explanation has been offered as to how the supposed result is accomplished. On the other hand is the evidence from experimental animals that vaccinated or previously infected animals may not be immune to the homologous virus and that the respiratory epithelium may be destroyed even though antibodies are present in the blood. How, then, can circulating antibodies prevent the pathogenic influence of the virus on these superficial cells?

In seeking information concerning the question our attention was directed to a consideration of factors which might be available in the environment of the vulnerable tissue. A study of the nasal secretions of human subjects revealed in them a substance capable of inactivating influenza virus. This substance has the characteristics of antibody both in its immunological and physico-chemical properties. It is present at birth, lost rapidly thereafter but beyond two years of age the frequency of its presence increases so that by school age it is present in a high proportion of human nasal secretions. It makes its appearance or increases in amount as a result of infection with the virus. In comparison with titers of neutralizing antibodies of the blood the substance is present in low concentration but in general those individuals with high levels of circulating antibodies have the more potent nasal secretions.

It was of interest to determine then whether subcutaneous vaccination exerted any influence upon the inactivating capacity of nasal secretions. A series of experiments was conducted last spring in which, before and after vaccination with influenza virus, both the blood and nasal secretions of a group of subjects were tested for their neutralizing capacity. It was found in those patients in whom a sharp response of humoral antibodies was observed, that the inactivating capacity of the nasal secretions was also enhanced.

The results suggest, therefore, that subcutaneous vaccination serves as a preventive by its influence upon the local protective mechanism which offers a more effective physiological defense than antibodies in the blood themselves. This concept attributes to circulating antibodies a secondary role of limiting the spread of the virus. After the virus has become established and engorgement and serous discharge takes place they may prevent the infection of other cells, as in the experimental animal they contribute to the prevention of pulmonary involvement by virtue of the lung's high vascularity. In the presence of an epidemic with marked incidence of pneumonia due to the virus that effect might result in a marked limitation of severity and mortality without comparable influence upon the incidence of infection. The experiments of Stokes and Henle, previously referred to, suggest that this was their major result.

While it is obviously a simple matter to stimulate circulating antibodies in man, it is much more difficult to demonstrate that immunity results from the procedure. A summary of evidence obtained with one form of vaccine has been recently presented by Horsfall. In these groups vaccine which was said to induce unusually high yields of antibody reduced the incidence of the disease by one third at most; in some groups no effect was discerned. The studies are still

in their primitive stage and there may be too great conservatism as to the nature of vaccinating material. As has been seen, however, there is more than a traditional basis for indicating the possibilities.

A second method adaptable to preventive use is the creation of active immunity by infection with modified virus or the setting up of subclinical infection. It represents the principle involved in the virus vaccines which have been most successfully utilized in human disease—smallpox, rabies, yellow fever. The application to influenza is readily seen. Introduction of influenza virus by routes other than the respiratory does not produce the disease. This has been demonstrated by the fact that human subjects given the fully active virus subcutaneously or intramuscularly do not give evidence of infection. In general, immunity resulting from infection by the natural route is a firmer immunity than that derived from vaccination by abnormal routes. The reasons are that under the former conditions the naturally susceptible cells are affected by the virus and receive the benefit of that stimulation while the systemic defenses also are subjected to the antigenic stimulus. The inoculation of active influenza virus into the respiratory tract would afford an opportunity for the respiratory epithelium to participate in the reaction. The possibility of initiating an epidemic is immediately put forward as an objection. Smorodintseff *et al.*, Burnet, and Stokes and Henle have, with the use of recently isolated strains of virus, caused frank disease of considerable severity. However, in the past few years, using the PRS strain cultivated in tissue culture or fertile eggs, we have demonstrated that the virus can be sprayed into the nostrils or introduced by packs soaked in virus, without producing clinical disease. In fact, the difficulty has been that the virus has been too greatly attenuated and results as measured by the development of circulating antibodies have been irregular. It may be, of course, that the response in terms of circulating antibodies is not a proper measure of the effect and that the influence upon the respiratory epithelium is much greater than the systemic evidence would indicate. This remains to be shown.

There is additional theoretical reason for suggesting the advantage of subclinical infection. In the fields of both plant and animal viruses it has been shown that the inoculation of an attenuated or mild strain of infectious agent will protect the host against a highly virulent strain given at the same time or shortly thereafter. This protection has been called interference, connoting that the mild virus competes successfully with the lethal strain for the privilege of occupying the susceptible cells, and is not based upon rapidly developing serological activities. Intranasal vaccination with the attenuated culture strain in the face of an outbreak might very well exert a similar influence.

There is need for further systematic exploration of vaccination by the intranasal route. *A priori* it presents a more rational and simpler opportunity than inoculations made by para-respiratory routes.

PASSIVE IMMUNIZATION

Turning from the question of active immunization it is of interest to consider the possibilities of conferring specific protection by means of passive transfer of antibody to the threatened individual. Since many subjects possess circulating antibodies at the time of illness, it is clear that to influence resistance by intravenous or intramuscular administration of serum would require relatively large concentrations of immune substances. Early in experimental studies when efforts were being made to develop technics for the measuring of antibody titers it became clear that serum given intraperitoneally was much less effective in preventing intranasal infection than when serum and virus were mixed and given by the intranasal route. This was further demonstrated by the studies by Laidlaw, Smith, Andrewes and Dunkin using the serum of immunized horses. Smorodintseff and Shishkhina reported for the first time in 1938 the observation that when immune serum was given intranasally before the virus infection and even for a period thereafter it was much more effective in protecting mice than the same serum given in much larger doses by other routes. Since then Stokes and his associates, Taylor, Hare and others, have adequately confirmed the results. In 1938 Nechaev published the results of the use of intranasal sprays of immune serum as a therapeutic agent in man. According to his statements, where given intranasally to patients in the first two days of illness, the serum was of definite therapeutic value. The following year Smorodintseff reported prophylactic studies on 650 men—again with favorable results. These were amplified by Smorodintseff, Gulmow and Tshalkwa, who reported that prophylactic administration reduced the incidence of influenza in 501 treated individuals to 8 per 1,000 while in 1,825 untreated an incidence of 82 per 1,000 was observed.

Recognizing the fact that the protective value of serum so administered is a temporary expedient it, nevertheless, may be found of considerable value in otherwise unprotected populations faced with an epidemic. The results all emphasize again the primary need of protecting the respiratory cells and the greater efficacy of immune substances available at the portal of entry. The addition of antibodies to the surface of susceptible cells by the use of immune serum is essentially a heightening of the virus-in-

activating capacity of the nasal secretions. Thus, local passive immunity, selectively applied, provides general immunity by breaking the infectious chain at the site of localization of the virus.

BARRIERS

Protection may be more than enabling an individual to combat an infectious agent which reaches him, but may represent, on the contrary, the use of agencies which have no immunological meaning. They do not give the susceptible individual resistance but serve to interrupt the passage of infectious material from the infected to the susceptible individual. The practices of isolation, quarantine and disinfection represent efforts in that direction. The first attempted, by limiting the quarters and associations of the sick individual, to decrease the opportunities for distribution; the second, quarantine, by curtailing the movements of a patient and his associates during a period in which disease might be incubating, has sought to limit the spread. The limitations in application are to a great extent those imposed by practical considerations of inability to restrain an individual sufficiently long to eliminate his participation as a spender of infection —as with streptococcicosis. Disinfection meant in many respects fumigation. It became apparent that disinfection of the premises had little effect when the human subject served as the chief distributor. Gradually, terminal disinfection was largely discontinued. Recently, however, it has reappeared under different guises intended for constant disinfection of the atmosphere.

The problem of the control of infections transmitted by way of the respiratory tract has been of increasing concern to pediatricians in charge of children's wards and institutions. The knowledge of the efficacy of ultraviolet light in killing bacteria and viruses suggested the application to nurseries, wards and schools. Under these conditions recent reports have attempted to create an erythematous opinion. While it is apparent that sterilization of the air may proceed, radiation has been most effective in small spaces in which motion is at a minimum and ventilation rigidly controlled. In fact, recent evidence indicates that satisfactory results are obtained only when the air is brought directly to the lamp. Moreover, some of the evidence is weighted by dissimilarity between control and test groups. Briefly, its application rests primarily on the assumption that air-borne dissemination is the important mode of spread of these diseases. In limited spaces with controlled ventilation and heavy contamination this may be true, but under normal conditions of activity, with open windows or outdoor associations, the probabilities of general control by ultraviolet irradiation can scarcely be anticipated.

Of greater promise because of simplicity is the use of aerosols. In the early days of the present conflict, French and British investigators drew attention to efforts toward air sterilization in bombproof shelters, barracks and hospital wards. Due again to their proven bactericidal properties, synthetic detergents in various vehicles were used for sprays. Decrease in the bacterial content of the air was accomplished, but various disturbances such as dust interfere with their efficacy. It was further noted that certain fumes, such as incense, were even more effective than aerosols. The next step was introduced by Robertson and his associates, who recognized that propylene glycol, which had been used merely as a base, was more effective than the agents mixed with it. It is readily volatile, requires no expensive equipment for its distribution, acts apparently in the gaseous phase rather than by changing surface tension and is active in high dilutions against pathogenic bacteria and viruses. At present there is excellent reason to believe that this non-toxic agent will fulfill a valuable function indoors but the out-of-doors is not readily subject to similar control. Disinfection revived is claiming important attention.

And now the lowly mask, after progressive decline and discard, has been dusted off, remodeled and shown by accurate physical measurements to fulfill a real function in preventing a ready distribution of minute particles of infected material. The ordinary gauze mask is not only *not* beneficial but actually harmful. The revised masks containing flannel filters which fit properly are shown to prevent deflection of infectious particles and to filter them out of the air; they become more efficient with use and laundering; they provide protection to the wearer and to the exposed susceptible. The new mask deserves place in the field of prevention.

Still another barrier is being earnestly sought—a drug which may be taken prophylactically and be available so as to render the arriving virus inert. Or, if rapidly effective, it may be employed so early after infection as to abort the incipient disease. Although this is anticipation, in view of rapid progress in the field of chemotherapy the period of waiting may be terminated at almost any time.

SUMMARY

Influenza has long been a field conducive to fancy and speculation. At present, however, through increasing knowledge of the pathogenesis of the disease and the factors influencing resistance, the collected

data are beginning to take form. In this discussion an effort has been made to point out the trends, to interpret their possibilities on the basis of the mechanisms involved, and to give some intimation as to their relative applicabilities and limitations. It is clear that certain of them offer reasonable promise of exerting a real effect in the prevention of influenza; it remains only to prove them.

OBITUARY

FRANK DAWSON ADAMS

ON December 29, 1942, Dr. Frank Dawson Adams died at his home, 1173 Mountain Street, Montreal. Dr. Adams was one of Canada's foremost men of science and one of her most distinguished citizens.

Born in Montreal, in September, 1859, he was educated at the Montreal High School and McGill University. Choosing geology as his major subject of study, a science then just coming into its own in Canada, he graduated with first rank honors in natural science in 1878, when only nineteen years of age. He subsequently studied at Yale University, Johns Hopkins and finally at Heidelberg. From the latter university he received his Ph.D. degree "summa cum laude" in 1892. From McGill he received the doctor of science degree in 1902 for distinction in science and later the LL.D. degree for distinguished public service.

His first appointment was in 1880 to the staff of the Canadian Geological Survey. He was appointed lecturer in geology at McGill in 1889 and Logan professor of geology in 1893. He was last but one of those who, receiving their inspiration from the late Sir William Dawson, by far the greatest principal McGill has had, was appointed to the staff of McGill by Sir William, whom he ultimately succeeded as head of the department of geology. During the succeeding years he arose step by step to merit almost every distinction which a man of science can hope to attain.

In Canada, Toronto, Queen's, Bishop's and Mount Allison Universities similarly honored him with the LL.D. He was early elected fellow of the Royal Society of Canada and later became its president. In Britain he was elected a fellow of the Royal Society of London and also of the Geological Society of London. By the latter society he was awarded the Wollaston Gold Medal, the greatest distinction the society has to offer. It was characteristic of him that when he received the cable telling him of the award, he first thought it was a mistake and that it must be meant for some one who happened to have the same name as himself.

He was equally recognized outside of Canada and the British Empire. He received honorary degrees from a number of American universities and had the unique distinction of being the only Canadian foreign associate member of the American Academy of Science. He was also elected foreign member of the Swedish Academy of Science, honorary member of the Mineralogical Society of Russia, of the Geological Society of Belgium and of many other scientific societies of equal distinction in other foreign countries. The International Geological Society elected him its president in 1913. The Geological Society of America elected him to a similar honor in 1918.

In Canada every effort to utilize more fully our economic resources received his loyal and hearty support. He was an active member of the Canadian Conservation Commission in the days when it was an active force in Canada and before political manipulation put it out of business. From the foundation of the National Research Council until his retirement from the university he was an active and distinguished member of that body and for a short time its executive chairman.

As a geologist he ranked first among his profession in Canada. For years a constant stream of papers came from his pen, covering almost every phase of Canadian geology. These appeared in the publications of the leading scientific journals in America and Britain, dealing with natural science problems. Altogether approximately ninety papers so appeared. From this long list it is difficult to select what might be considered most important. Perhaps the papers which gave him the greatest satisfaction were: "The Transfusion of Matter from one Solid to Another under the Influence of Heat"; "An Experimental Investigation in the Flow of Marble" (with J. T. Nicolson); "Experimental Investigation of the Compressibility and Plastic Deformation of Certain Rocks" (with Ernest C. Coker); "Experimental Work on the Flow of Rocks"; "An Experimental Contribution to the Question of the Depth of the Zone of Flow in the Earth's Crust"; "On the Origin and Nature of Ore Deposits—an Historical Study"; "On the Amount of Internal Friction Developed in Rocks during Deformation, and of the Relative Plasticity of Different Types of Rocks" (with J. A. Bancroft).

These researches, extending over a number of years, dealing with the flow of rocks under changing conditions of temperature and pressure, carried on with the support of the Carnegie Foundation, remain a permanent contribution to our knowledge of the manner in which internal changes in the structure of the earth were brought about in geological time. They were

remarkable both because of the mechanical ingenuity involved in the study and for the results obtained.

His last contribution to science, "The Birth and Development of the Geological Sciences," is the one in which he doubtless took the greatest pride. It will without question remain a standard work on the subject for many generations. To find the material he visited all the great libraries of Europe and America where information was to be found. For this purpose he collected a splendid library on the history of the physical sciences. Just a few weeks before his death he completed the cataloguing of this library and handed it to McGill University, a splendid gift, in some ways unique, which cost many thousands of dollars.

His studies, however, had a much wider range than Canada. He traveled widely. Everywhere he went geology was his major interest. For example, after his retirement, on a trip around the world he visited Ceylon, and his study of "The Geology of Ceylon," published in the *Canadian Journal of Research*, is a major contribution to that subject and was an important factor in stimulating the Geological Survey of India to intensify its activities.

Just a word about the man—modest but not retiring he had a zeal for knowledge that was unremitting; kindly and considerate in his relation with others, he was nevertheless firm in his purpose to accomplish the task in hand. Because of these qualities and his strong sense of justice and fair play he won the respect and good will and confidence of both the students of his faculty and the professors and instructors. He was one of a small group responsible for the establishment of a graduate faculty at McGill and was its first chairman. As dean of the faculty of applied science and later as vice-principal and for a time acting principal, he showed the same qualities in administration as he had shown in his scientific work.

It was my good fortune to be associated with him in various ways for the past fifty years. Although the activities of my life led me far afield we always maintained a close and affectionate friendship. I worked with him on the Conservation Commission, on the National Research Council and in many religious and social activities. He was with me as assistant director of the Khaki University overseas during World War I. In my fifty years of association with university work I know of no one who seemed so completely to have found and maintained that balance of kindness of heart and firmness of purpose which was especially characteristic of him. He had a great gift of friendship—the value of which I richly experienced. He had a deep sense of the value of the religious life. While holding firmly to his own views, he was broad-minded and tolerant of those who differed from him. He lived the doctrine of human brotherhood.

H. M. TORY

AMIN FAHD MALUF PASHA

MAJOR-GENERAL AMIN FAHD MALUF PASHA, B.A., M.D. (American University of Beirût), formerly principal medical officer of the Iraq Army, died at his home in Heliopolis, Egypt, on January 21, in his seventy-first year, after a prolonged illness. He began his career in military medicine as an officer in the Egyptian Army and served a few years in the Sudan. Upon the Arabian Revolt in the last war, he resigned his position in the Egyptian Army and joined King Feisal's troops as a surgeon. He was decorated ten times. Toward the end of the war he nearly succumbed to an attack of typhus. He was elevated from colonelcy and created a Pasha on his retirement about fifteen years ago. He was much interested in the structure and habits of animals. His latest works are "An Arabic Zoological Dictionary" (Cairo: Al-Muktataf Press, 1932, 271 pp.) and "An Astronomical Glossary" (Cairo: Egyptian Library Press, 1935, 142 pp.). He was held in high regard by his colleagues and acquaintances notwithstanding the reserve and forthrightness which so often characterizes a soldier who cheats death several times and who dedicates his bachelor life to the state.

N. S. R. MALUF

RECENT DEATHS

DR. EDWIN B. TWITMYER, professor of psychology at the University of Pennsylvania, director of the Psychological Laboratory and Clinic, died on March 3 at the age of sixty-nine years. He had been a member of the faculty of the university for forty-six years.

DR. FRANK STURDY SINNATT, director of the Fuel Research Station of the British Department of Scientific and Industrial Research, died on January 27 at the age of sixty-two years.

THE death is announced in Indo-China of Dr. Alexandre Emile John Yersin, a director of the Pasteur Institute in Paris. He was sixty years old. Dr. Yersin established the first colonial Pasteur Institute at Nha Nang, Annam, and later was appointed inspector general of all four institutes in that area. The other three institutes are in Saigon, Hanoi and Dalat. He also founded a branch institute under the auspices of the Chinese government at Canton.

PROFESSOR A. K. CAJANDER, three times Prime Minister of Finland, died on January 21 at the age of sixty-four years. He was the leading Finnish forestry expert. From 1904 to 1911 he was lecturer in botany at Helsinki University, and in 1911 he became professor of forestry. He was also director-general of the State Board of Forestry.

SCIENTIFIC EVENTS

THE NUFFIELD FOUNDATION

LORD NUFFIELD has authorized the following announcement which is printed in *The Times,* London.

Lord Nuffield has intimated his intention of founding forthwith a charitable trust, which will be known as "The Nuffield Foundation."

He desires to make this donation from resources which have been built up through private enterprise, in the essential importance of which he is a firm believer. He wishes, in so doing, to record his view that the spontaneous contributions which come from such sources to the service of the community are, and must always remain, a vital factor in the life of the nation.

Lord Nuffield will, therefore, hand over to trustees his shareholdings in the Nuffield Organization to the value of £10,000,000 as a capital fund. The income from this fund will be administered by managing trustees, who will not exceed seven in number. He has appointed the following as managing trustees:

Sir William M. Goodenough (chairman).
Sir John S. B. Stopford, F.R.S. (vice-chairman).
Professor F. L. Engledow, B.Sc.
The Hon. Geoffrey C. Gibbs.
Sir Hector Hetherington.
Sir Henry T. Tizzard, F.R.S.
Miss Janet Vaughan.

Lord Nuffield wishes to make it clear that in carrying out this arrangement he is not in any way withdrawing from his association with his businesses, with which he will be personally identified in the same way as heretofore.

The objects which the trustees will endeavor to assist are as follows:

1. Medical research and teaching.
2. The organization and development of medical and health services.
3. Scientific research and teaching in the interests of trade and industry.
4. The pursuit of social studies.
5. The care and comfort of aged persons.

The normal scope of the trust's activities will be Great Britain and Northern Ireland. Attention may, however, be given to projects particularly affecting the Empire, and in regard to items 1 and 3 above the provision of scholarships and other assistance for Empire students is included. It is provided that Lord Nuffield's trusts which are already in being may benefit from the income of the new trust.

The managing trustees are enjoined to consult the appropriate Ministers or Departments of State in connection with any matters of major importance in which they may become interested. They are not, however, to be in any way bound by the views expressed by these ministers or departments in carrying out the work of the trust.

THE WORK OF SOVIET ASTRONOMERS AT LENINGRAD DURING THE SIEGE[1]

THE Soviet Scientists' Antifascist Committee has sent a report dealing with the work carried on by Leningrad astronomers during the time of the siege of the city by the Germans to the American Association of Scientific Workers. It was prepared by Lydia Bach, of Moscow. It reads:

Professor I. D. Jongolovich, head of the Leningrad branch of the Institute of Astronomy of the Academy of Sciences of the U.S.S.R., has come by plane to Moscow for a few days and told us of the activities of Leningrad's astronomers. Last winter, when scientific research institutes were being evacuated from Leningrad, we were also urged to leave our embattled city in order to continue our astronomic research in the quiet of the Soviet rear. However, sixteen of us decided to remain in Leningrad and go on with our astronomic observations despite the stress of the blockade.

The Leningrad Astronomic Institute has issued a series of astronomic almanacs for geodetic workers, navigators and pilots. The "Astronomic Almanac" for 1943 contains extensive information on changes of the position of the sun, the moon, planets and stars in the course of the year. The information is rendered with the exactitude demanded by the work of large observatories as well as for astronomic and geodetic measurements. At the beginning of the war the Soviet "Astronomic Almanac" was considerably expanded so that it now fully replaces almanacs issued abroad. The matrices of the "Astronomic Almanac of USSR" for 1943 were brought to Moscow by plane from Leningrad to be published by the Academy of Sciences of the USSR.

The "Nautical Astronomic Almanac" for 1943 contains data from the "Astronomic Almanac of USSR" in the form necessary for navigation in all the seas and oceans. The "Aviation Astronomic Almanac" is a guide to pilots which is particularly important for long-distance flights.

At present, simultaneously with its other activities, the Leningrad branch of the Institute of Astronomy has already begun to prepare data and tables for the Almanacs for 1944.

GRANTS FOR RESEARCH IN TUBERCULOSIS

THE Committee on Medical Research of the National Tuberculosis Association has recommended to the board of directors of the association that the following researches be aided with grants from the

[1] Transmitted via radio to the American Association of Scientific Workers by Sergei Pilipchuk, Secretary of the Soviet Scientists' Antifascist Committee, February 12, 1943.

association, effective from July 1, 1943, to June 30, 1944.

"Chemistry of the tubercle bacillus," under the direction of Professor R. J. Anderson, Sterling Chemistry Laboratory, Yale University.

"Chemistry of tuberculin and serum studies of tuberculosis," under the direction of Dr. Florence B. Seibert, Henry Phipps Institute, University of Pennsylvania.

"Enzymes as factors in resistance to tuberculosis," under the direction of Dr. M. C. Winternitz and Dr. Bruno Gerstl, Laboratory of Pathology, Yale University.

"Relationship of diabetes to tuberculosis," under the direction of Dr. M. M. Steinbach, Department of Bacteriology, Columbia University.

"Correlation of x-ray and tuberculin diagnostic studies," under the direction of E. B. Fred *et al.*, University of Wisconsin.

"Improvement in x-ray technique," under the direction of Professor Charles Weyl, Moore School X-ray Laboratory, University of Pennsylvania.

"Development of a virulence test," under the direction of Dr. C. E. Woodruff, Wm. H. Maybury Sanatorium, Northville, Michigan.

"Recovery of T. B. fractions in the urine, a possible activity test," under the direction of Dr. John R. Paul, School of Medicine, Yale University.

"Clinical study and follow-up of babies to adolescence," under the direction of Dr. Edith M. Lincoln, Bellevue Hospital, New York City.

"Influence of war and industrial changes on tuberculosis," under the direction of Dr. Carroll E. Palmer and Dr. Herman E. Hilleboe, of the U. S. Public Health Service.

"Course and prognosis of the minimal lesion in tuberculosis," under the direction of Dr. Carroll E. Palmer and Dr. Herman E. Hilleboe, of the U. S. Public Health Service, and others.

"Development of an organization to evaluate chemotherapeutic agents in tuberculosis," under the direction of a special committee.

The members of the Committee on Medical Research are Dr. Charles J. Hatfield, Dr. Kendall Emerson, Dr. Charles A. Doane, Dr. Leroy U. Gardner, Dr. Esmond R. Long, Dr. Karl F. Meyer, Dr. Florence R. Sabin, Dr. David T. Smith, Dr. H. S. Willis, Dr. Julius L. Wilson and Dr. Wm. Charles White, *chairman.*

THE SCIENCE TALENT SEARCH[1]

FORTY boys and girls, all graduating seniors in public, private and parochial schools, have been selected in the second nation-wide science talent search just concluded at Washington to receive science scholarships amounting to $11,000.

One boy and one girl each received a Westinghouse Science Grand Scholarship of $2,400, and eight others received Westinghouse Science Scholarships of $400 each. The grand scholarships were awarded to Raymond Reinhart Schiff, 16, of New Rochelle, N. Y., and Gloria Indus Lauer, 17, of Ames, Iowa.

Additional one-year scholarships of $100 each were awarded to 30 seniors who also attended the Science Talent Search Institute from February 26 through March 2 in Washington.

Each of the ten top scholarships is for four years and all the scholarships may be used in study at any college or university that the student desires to attend, if the school he chooses shall meet the requirements of the scholarship awarding committee. If the student enters military or other government service, his scholarship will be held in trust by Science Service for his use after the war, or until such time as he is in a position to accept it.

The second annual Science Talent Search began last November when some 25,000 school principals and teachers were asked to cooperate in finding the graduating seniors—both boys and girls—who appeared most likely to succeed as scientists. About 15,000 students who entered the search were given a science aptitude examination administered by their school officials.

Each entrant who completed the aptitude examination—about 3,400—was asked to write an original essay on "Science's Next Great Step Ahead"; the essay, together with scholarship and personal records, was submitted to the Science Talent Search board of judges by the school officials of the entrant.

The aptitude examination was specially prepared for the Science Talent Search by Dr. Harold A. Edgerton, director of the Occupational Opportunities Service of the Ohio State University, and Dr. Steuart Henderson Britt, director of the Office of Psychological Personnel of the National Research Council and professor of psychology at George Washington University. The aptitude examination was designated to test powers of observation and deduction, rather than knowledge of science.

On the basis of the scholarship and personal records, the essays and the science aptitude examination, students were chosen as delegates to the Institute of the Science Talent Search. During sessions of the institute, the forty young delegates—29 boys and 11 girls—were interviewed by the judges and given final examinations. On the basis of the interviews and examinations, the scholarships were awarded.

Dr. Edgerton and Dr. Britt, with Dr. Harlow Shapley, director of Harvard College Observatory, constituted the scholarship awarding committee.

Speakers at the institute, who followed the general theme of "Science's Next Great Step Ahead," included Dr. Shapley; Dr. Hugh S. Taylor, professor of chemistry, Princeton University; Dr. Eleanor

[1] Telegram from C. N. Fry, Westinghouse Electric and Manufacturing Company.

Bliss, the Johns Hopkins University School of Medicine; Père Artheme Dutilly, missionary-scientist of the Oblate Missions and the Catholic University of America; Dr. Edwin G. Conklin, president, American Philosophical Society, and also president of Science Service; Dr. H. L. Dryden, president, Institute of the Aeronautical Sciences, and Dr. Marshall H. Stone, president, American Mathematical Society.

The Science Talent Search is conducted annually by the Science Clubs of America, sponsored by Science Service, and the Westinghouse Electric and Manufacturing Company. The Westinghouse Company provides the scholarships as an inspiration to scientific achievement in America.

The eight young scholars who received $400 Westinghouse Science Scholarships were: Charles Poultney Perot, 17, Lancaster, Pa.; Thomas Richard Quermann, 17, Clarksburg, W. Va.; Josiah Macy, Jr., 17, Warrenton, Va.; Donald Rosswell Harris, 17, Johnstown, Pa.; William Weidman Piper, 17, Columbus, Ohio; Henry Hiram Kohl, 16, Newburgh, N. Y.; Elizabeth Ann Lean, 17, Shorewood, Wis.; and Virginia Ellen March, 16, Madison, Wis.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE election of officers for 1943 was delayed because of cancellation of the New York meeting. By a mail ballot of the council, a procedure that is valid under the constitution of the association, the following were elected. It was necessary to take a second ballot for president, since no person received a majority vote.

VICE-PRESIDENTS OF SECTIONS

Mathematics (Section A): F. D. Murnaghan, the Johns Hopkins University.

Physics (Section B): J. W. Beams, the University of Virginia.

Chemistry (Section C): Arthur J. Hill, Yale University.

Astronomy (Section D): Otto Struve, Yerkes Observatory.

Geology and Geography (Section E): John K. Wright, American Geographical Society.

Zoological Sciences (Section F): Carl R. Moore, the University of Chicago.

Botanical Sciences (Section G): W. J. Robbins, the New York Botanical Garden.

Anthropology (Section H): Robert H. Lowie, the University of California.

Psychology (Section I): Herbert Woodrow, the University of Illinois.

Social and Economic Sciences (Section K): F. Stuart Chapin, the University of Minnesota.

Historical and Philological Sciences (Section L): Henry E. Sigerist, the Johns Hopkins University.

Engineering (Section M): Thorndike Saville, New York University.

Medical Sciences (Section N): Paul D. Lamson, Vanderbilt University.

Agriculture (Section O): R. E. Buchanan, Iowa State College.

Education (Section Q): Harold F. Clark, Columbia University.

MEMBERS OF THE EXECUTIVE COMMITTEE

J. McKeen Cattell, editor of SCIENCE, Lancaster, Pa.

Burton E. Livingston, professor emeritus, the Johns Hopkins University.

Kirtley F. Mather, Harvard University.

ELECTED MEMBERS OF THE COUNCIL

Lawrence K. Frank, National Resources Planning Board, Washington, D. C.

Paul C. Kitchin, the Ohio State University.

In accordance with the constitution, the following section committeemen were elected by the respective sections for a four-year term expiring at the close of the meeting of December–January, 1946–1947:

Mathematics: G. Baley Price, University of Kansas.

Physics: Elmer Hutchisson, 35 W. 57th St., New York, N. Y.

Chemistry: R. M. Burns, Bell Telephone Laboratories.

Astronomy: Jason J. Nassau, Case School of Applied Science.

Geology and Geography: Ralph H. Brown, University of Minnesota.

Zoological Sciences: Clarence L. Turner, Northwestern University.

Botanical Sciences: Walter F. Loehwing, University of Iowa.

Anthropology: Julian H. Steward, Bureau of American Ethnology, Smithsonian Institution.

Psychology: H. E. Burtt, the Ohio State University.

Social and Economic Sciences: Frederick F. Stephan, War Manpower Commission, Washington, D. C.

Historical and Philological Sciences: Conway Zirkle, University of Pennsylvania.

Medical Sciences: Dallas B. Phemister, University of Chicago.

Agriculture: Emil Truog, University of Wisconsin.

Education: Edward S. Evenden, Columbia University.

SCIENTIFIC NOTES AND NEWS

THE Vaughan Research Award in Horticulture for the best paper presented before the American Society for Horticultural Science and published in its *Proceedings* in 1942 has been made in the field of vegetable crops to Dr. O. A. Lorenz and Dr. J. E. Knott, of the University of California at Davis, for their paper entitled "Studies of Graywall of Tomato," which appeared in Volume 40. This award of $500

is made through the generosity of Leonard H. Vaughan, of the Vaughan Seed Stores, Chicago. Preference is given to papers that present new discoveries and which show promise of commercial importance in practical application.

THE managers of the Royal Institution have awarded the Actonian Prize of 100 guineas for the year 1942 to Dr. Alexander W. G. Ewing and Mrs. Ewing for their investigation concerning deafness and hearing aids.

THE Council of the British Geological Society announces the following awards: The Wollaston Medal to Professor A. E. Fersman; the Murchison Medal to Professor A. Brammall; the Lyell Medal to D. N. Wadia, lately of the Geological Survey of India; the Bigsby Medal to Dr. G. M. Lees, chief geologist of the Anglo-Iranian Oil Company; the Wollaston Fund to Miss Ethel D. Currie; the Murchison Fund to A. G. Davis; one moiety of the Lyell Fund to F. A. Bannister and another moiety to M. H. Hey.

AT a recent meeting of the Council of the Society of Chemical Industry, London, the award of honorary membership was conferred on Dr. Harold Hibbert, E. B. Eddy professor of industrial and cellulose chemistry at McGill University. In his absence the scroll was received in his behalf by the Canadian High Commissioner, the Right Honorable Vincent Massey. In making the award the president said that "the council in deciding to bestow this honor selected with great care one they considered worthy, for his career illustrates to a remarkable degree the great influence which a man of high scientific attainments can exert on industry and on the well-being of the community."

DR. JOSEPH L. WILLIAMS, associate professor of biology and chemistry at Lincoln University, Pennsylvania, has been elected a fellow of the Royal Entomological Society of London.

R. V. SOUTHWELL, rector of the Imperial College of Science and Technology, formerly fellow of Brasenose College and professor of engineering science at the University of Oxford, has been elected to an honorary fellowship at Brasenose College.

ROY B. WHITE, president of the Baltimore and Ohio Railroad, has been elected chairman of the Board of Trustees of the Maryland Academy of Sciences. He succeeds Herbert A. Wagner, chairman of the Consolidated Gas Electric Light and Power Company of Baltimore. Mr. Wagner was named honorary chairman of the academy.

AT a business meeting of the Botanical Society of America, held in the Biological Laboratories of Harvard University on February 8, new officers were elected and members appointed on special committees. The newly elected president is Dr. William J. Robbins, director of the New York Botanical Garden. Professor George S. Avery, Jr., Connecticut College, was elected vice-president. Professor Arthur J. Eames was reelected a member of the editorial board of the *American Journal of Botany,* the official journal of the society. The newly appointed representatives of the society on the council of the American Association for the Advancement of Science are Dr. P. W. Zimmermann and Dr. F. D. Kern. Members of the Committee on Nomenclature, the Committee on Botanical Teaching and the Emergency War Committee were reappointed for another year.

DR. C. E. MCCLUNG, professor of zoology emeritus of the University of Pennsylvania, has been appointed to act as chairman of the department of zoology at Swarthmore College during the absence of Professor Laurence Irving, who has been commissioned Major in the Army Air Corps and ordered to the Air Forces Proving Ground Command, Elgin Field, Florida. Professor Robert K. Enders has also been instructed to report for military service. Dr. C. Brooke Worth was commissioned in the Medical Corps several months ago. Other members of the department who will soon leave for military service are Dr. P. F. Scholander, George A. Edwards, Lloyd Merritts and Henry Mahler.

THE Zoological Society of Philadelphia announces the appointment of Dr. David L. Coffin, instructor in veterinary pathology at the University of Pennsylvania, to the Herbert Fox memorial fellowship in comparative pathology. Dr. Coffin will serve as assistant to Dr. Herbert L. Ratcliffe, who is the newly appointed director of the Penrose Research Laboratory of the Zoological Society of Philadelphia, and also as assistant professor of comparative pathology at the University of Pennsylvania. Thus, a long-established practice of joint staff appointments between two well-known Philadelphia institutions will be continued. This fellowship, established in 1942 in memory of Dr. Herbert Fox, pathologist and director of the Penrose Research Laboratory from 1907 to 1942 and professor of comparative pathology at the University of Pennsylvania from 1927 to 1942, provides for half-time work at the Zoological Garden by faculty members of the School of Veterinary Medicine of the university who are interested in the diseases of wild animals.

Museum News states that Manuel Urrutia, director of the National Museum of Hygiene, Mexico City, at the suggestion of the Pan American Sanitary Bureau, has become an interne for three months at the Cleveland Health Museum.

G. K. HICKIN, formerly with Merck and Company, Inc., recently has been appointed head of chemical

engineering design for the B. F. Goodrich Company, Akron, Ohio.

Dr. Alexander L. Bassin, assistant professor of orthopedic surgery at the Yale School of Medicine and associate surgeon (orthopedist-in-chief) of the New Haven Hospital, reported on March 1 for active duty at St. Albans, L. I., as a Lieutenant Commander in the Medical Corps of the Navy.

Dr. William F. Diller, assistant professor of zoology at the University of Pennsylvania, has been commissioned a first lieutenant in the United States Army.

Alexander B. Klots, of the department of biology of the College of the City of New York and of the department of entomology of the American Museum of Natural History, has been commissioned a captain in the Sanitary Corps and is stationed at Camp Joseph T. Robinson, Arkansas.

At Iowa State College the following members of the faculty have leave of absence to permit them to take commissions in the food and nutrition section of the sanitary corps of the United States Army: Captain H. L. Wilcke, head of poultry husbandry; Captain A. L. Anderson, associate professor of animal husbandry, and Lieutenant W. J. Shannon, assistant professor of chemistry.

Dean Albert B. Newman, of the School of Technology of the College of the City of New York, has been appointed regional representative of the War Man-Power Commission for New York State. He will act in an advisory capacity to the war-training programs in this area, which include projects of the National Youth Administration, the U. S. Office of Education and private industry.

The Times, London, reports that R. A. McCance, who is an authority on the chemical composition of foods and nutrition, is making a lecture tour of Spain and Portugal, arranged by the British Council. He is to speak in Portugal on "The Physiology of Infancy" and in Spain on "Progress and Problems in Mineral Nutrition."

Dr. E. G. Gerwe, until recently director of laboratories of the William S. Merrell Company, of Cincinnati, joined the staff of E. R. Squibb and Sons, New York, on February 1. He is in charge of the control divisions of the pharmaceutical and chemical manufacturing laboratories of the Squibb plants in Brooklyn and New Brunswick, N. J.

Dr. Charles Putnam Symonds, Air Commodore in the Royal Air Force, consultant in neurology, delivered on March 10, 11 and 12 at 5 o'clock at the Harvard Medical School a series of Edward K. Dunham Lectures for the promotion of the medical sciences. His subject was "The Human Response to Flying Stress."

Dr. Henry Norris Russell, professor of astronomy at Princeton University, delivered a public lecture at the University of California at Los Angeles on March 3. The lecture, entitled "Science Looks at God," was given under the auspices of the University Committee on Lectures, Music and Drama.

Dr. C. E. Marshall, professor of soils at the University of Missouri, lectured at Iowa State College on February 24 and 25. He spoke on "The Chemical Environment of the Plant in the Soil" and on "Some Electrochemical Properties of Membranes and Their Relationship to Problems of Biology and Agriculture."

Dr. Karl Paul Link, professor of biochemistry at the University of Wisconsin, delivered on February 25 the Edward C. Lee Memorial Lecture in Chemistry in the Kent Chemical Laboratory of the University of Chicago. His address was entitled "From the Haystack to the Clinic via Coumarin Chemistry."

The initiation of new members into the Smith Chapter of the Society of the Sigma Xi will take place on Thursday, March 18. The initiation will be preceded by a business meeting of the chapter, and will be followed by a dinner and public lecture. The lecturer will be Professor George Wald, of the Biological Laboratories of Harvard University, who will speak on "The Evolution of Vision and the A Vitamins."

Sir Stafford Cripps, British Minister of Aircraft Production, was the principal speaker in a discussion on the organization of science in war-time at a conference held on January 30 by the British Association of Scientific Workers. Sir Laurence Bragg was one of the speakers in a discussion on scientific planning, which took place on the following day.

The twenty-second annual conference of the North Central States Entomologists will meet at Purdue University on March 25 and 26. The program will deal with insect problems of the Armed Forces, Priority Chemicals and Insecticide Substitutes, and Protection of Crops and Animals Essential to the War Effort. The Central Plant Board will meet at Purdue on the two preceding days, the Extension Entomologists on the twenty-fourth, followed by the Chinch Bug Conference in the evening.

The Medical College of Virginia, Richmond, will sponsor a symposium on nutrition which will be held on March 25, 26 and 27. Addresses will be given by Dr. J. C. Funk, director of health education, State Health Department, on "Nutrition Activities of the State Department of Health," and by Dr. W. H. Sebrell, of the National Institute of Health, on "Nu-

trition in a Changing World." The following day a series of papers on various aspects of nutrition is planned. There will be a dinner at 7 P.M., at which Dr. V. P. Sydenstricker, of the University of Georgia, will give an address on "War-time Nutrition in England." On Saturday morning a panel discussion will be led by Dr. Lydia J. Roberts, of the University of Chicago, on "Teaching Nutrition Material to Elementary School Children."

THE Society of Rheology and the Polytechnic Institute of Brooklyn will hold a joint research conference on "The Present State of the Kinetic Theory of Rubber Elasticity" on Saturday, April 3, at 10:30 A.M. at the institute. The program includes a paper by Dr. M. L. Huggins, of the Eastman Kodak Company Research Laboratory, Rochester, N. Y., on "Statistical Treatment of Long Chain Molecules," and by W. L. Wood, of the National Bureau of Standards, on "The Present Experimental Aspect of Rubber Elasticity." These papers will be discussed by authorities in the subjects.

THE Executive Board of the American Public Health Association announces that the association will sponsor a three-day Wartime Public Health Conference in New York City on October 12, 13 and 14. The seventy-second annual business meeting of the association will be held in connection with it. The program will be devoted exclusively to wartime emergency problems as they affect public health and the public health profession.

ACCORDING to the *Journal* of the American Medical Association the research prize of $500 of the American Urological Association will not be awarded this year and plans for the June meeting in St. Louis have been cancelled. The American Association for the Study of Goiter has postponed all meetings for the duration of the war. All officers will hold their positions until the next meeting of the association. The 1943 session of the American College of Chest Physicians has been cancelled.

The Times, London, reports that at a meeting of the Royal College of Surgeons of England, Dr. J. Newman Morris conveyed a message of greetings from the Royal Australasian College of Surgeons. In return the president handed to him, as a token of friendship to the sister college, a First Edition (1664) of Willis's Anatomy, the illustrations of which are by Sir Christopher Wren.

DISCUSSION

THE FUNDAMENTALS OF SALMON CONSERVATION[1]

THE conservation of the salmon fisheries is a matter of momentous importance in view of a promise of a real food shortage in the not too distant future. In addition to this we owe it to posterity to preserve the anadromous fishes since it is through these fishes that the vast oceanic plankton is in part made available, which is otherwise unavailable as food for man.

The most efficient conservation methods can be developed only through an understanding of the fundamental factors affecting the migratory movements of these fishes.

It has now been shown that salmon and certain other fishes do respond to a carbon dioxide tension gradient.[2,3,4] That there is more than a probability that there is a carbon dioxide tension gradient from the spawning streams to the oceanic feeding grounds has been demonstrated.[5] Powers and Clark[4] have shown that the brook trout and the rainbow trout not only respond to very slight carbon dioxide tension gradients but that these fishes respond to the carbon dioxide tension gradient through receptors located in the lateral line organs.

It now remains to put the culminating tests to the salmon themselves. This can be done by two simple methods. First, the gradient tank technique can be employed to determine the capacity of the adult salmon, with and without lateral line nerves bilaterally sectioned just distal to the gills, to respond to very slight carbon dioxide tension gradients. Second, as in the past homeward bound salmon could be tagged and liberated. The lateral line nerves could be bilaterally sectioned just distal to the gills of one out of each two salmon tagged. If the salmon do find their way back to their home stream through a response to a carbon dioxide tension gradient through receptors located in the lateral line organs, the salmon with lateral line nerves bilaterally sectioned should be less apt to find their home stream than those with their lateral line nerves intact. The only complicating factor that might be involved would be the gregarious habits of the salmon. Even then those with lateral line nerves bilaterally sectioned should be less apt to find schools and in turn would be more apt to be lost from schools than those with lateral line nerves intact.

Since the author will most likely never be permitted to carry out these tests himself, he is publishing these suggestions in the hope that these tests will be made

[1] Contribution No. 10, Department of Zoology and Entomology, University of Tennessee, Knoxville.

[2] V. E. Shelford and E. B. Powers, *Biol. Bull.*, 28: 315, 1915.

[3] E. B. Powers, *Publ. Puget Sound Biol. Sta.*, 22: 1, 1921.

[4] E. B. Powers and R. T. Clark, *Ecology*, 24: 100, 1943.

[5] E. B. Powers, *Ecology*, 22: 1, 1941.

by workers now in the field since there is a minimum of additional expense and effort involved.

EDWIN B. POWERS
UNIVERSITY OF TENNESSEE,
KNOXVILLE

A PLEA

THIS is a plea from one who likes, occasionally, to run as he reads. In wartime censorship is vital. In the days of 1918 "somewhere in France" became a familiar figure of speech. But the knowledge concealed by the title of a scientific paper such as "The Genus *Oochoristica* Lühe 1898" conceals nothing of value except from the wistful seeker after knowledge. Only after a study of such an article is he delighted or disappointed to learn that the aforesaid *Oochoristica* is taxonomic sanctuary for "forty-five valid species of tapeworms parasitic as adults in reptiles and mammals." This title confusion is being slowly clarified, but there is another which is much worse.

I have just read that a certain copepod in which I was interested was taken in two hauls, one in 11° 18′N, 78° 34′W, and the second 6° 32′N, 80° 04′W, but only detailed search through a footnote or time-consuming labor with an atlas and a pair of dividers reveals the important fact that the hauls were made in different oceans.

I have often wondered whether I am alone in abyssal ignorance of the relative positions of such localities as 40° 33′N, 74°W, and 40° 33′S, 74° E, or whether there are others who are grateful for the trouble I have always taken in adding to 39° 15′N, 72°W and 2° 59′N, 78° 11′W, the sub-titles, 125 miles S E of New York City, and Gorgona Island, Colombia, respectively.

WILLIAM BEEBE
NEW YORK ZOOLOGICAL SOCIETY

RUSSIAN NAMES

IN SCIENCE of February 19, p. 178, Professor Neugebauer gives a useful list of recent contributions to pure mathematics in Russia. This list could and should be extended to other contributions of value, printed periodically in the "Doklady" of the Soviet Academy. They are in excellent English (or French), and relate to physics, chemistry and all branches of natural history. However, the direct object of these few words is to call attention to the need of a definite rule in the transliteration of the Russian names. The faults in the list given in this respect are not those of the referent, but they are faults nevertheless and should be avoided in our publications.

The rules are simple enough. There is no "w" in the Russian alphabet, but only "v"; the letters "f" or "ff" never in Russian end a name, the terminal consonant being invariably "v"; and the "tsh" or "tch" is generally "č," with the exact sound of the "ch" in "cherry." As it is, the terminal "v" in the names quoted is given four times correctly, five times as "w" and four times as "ff"; while the "č" (now written thus not only in the Slavic languages but also in the German and occasionally even in the English) is given in most cases as the clumsy "tsh" or "tch."

As the use of the Russian names by American scientists may well be expected to go on increasing, it would seem only sensible to adapt definite and correct rules for their transliteration, even if the errors should come from Russia itself or from the authors. The latter I found endeavor often to conform to what seem to be the wishes of their English-speaking colleagues.

A. HRDLIČKA
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SPECIAL CORRESPONDENCE

THE WAR MANPOWER SITUATION IN PHYSICS

THIS statement should be read in connection with the item entitled "Suggestions from the Office of Scientific Personnel of the National Research Council" which appeared in the January 1 number of SCIENCE and which called attention to the need for recruiting teachers of physics from the ranks of other departments or from other sources. Only in this way can bidding among institutions be prevented, which would make more difficult the meeting of the shortage. In each department there must be a nucleus of regular teachers if it is to successfully assimilate the additional staff.

It is now possible to say definitely that, on the average, for every physicist engaged in college teaching in January of this year there must be at least one and one half teachers of physics recruited from other sources. This ratio is based on official information regarding presently available teachers of physics and the number of teachers needed adequately to take care of the urgent demands that will be made by the Army and Navy training programs, as well as what will remain of normal programs. In view of this situation, no institution has a right to recruit teachers of physics from any college which is at all likely to have a training unit or to have a sufficiently large enrolment of women, younger men and physically disqualified men to justify the continuance of the department. If, after the training programs are under way, any institution has a ratio of genuine to "ersatz" teachers of physics higher than one to one and one half, it will find itself open to severe criticism if any of the ex-

perienced teachers have been recruited from institutions needing them.

As a matter of fact, the demand for physicists to engage in war research and various war activities other than teaching continues and as many research physicists as possible should be released from teaching obligations, thus making it all the more important that as many new teachers of physics as possible should be recruited. Even with the recognition by Selective Service of the importance of continuing physics students in training, advanced undergraduate and graduate work will make lighter demands than normal upon staff time except in the small number of institutions where the Army and Navy training programs call for advanced work. Therefore, in many institutions there will be physicists who can serve the war effort better by going into war research than by teaching beginning physics. Such men should be released and are urged to register with the Office of Scientific Personnel.

Several institutions have anticipated this teacher shortage and have canvassed their own faculties and other sources for potential teachers of physics, mathematics and other subjects in which shortages will occur. Some departments of physics have already inaugurated intensive refresher courses in which prospective teachers thoroughly review beginning physics, solve all the problems of the course, and perform the demonstration and laboratory experiments. Even though the new teachers may not be called upon to give demonstration lectures or to teach in the laboratory, this work with equipment furnishes a most effective form of review. It vitalizes and clarifies the "book learning" that might otherwise appear to be sufficient. It also serves to make each teacher familiar with what goes on in the entire course.

Many departments of physics have available some graduate and senior students who can immediately be called upon to serve as teachers. This has been taken into account in the estimates. Most departments, however, will have to meet most or all of the demands for staff expansion by recruitment from the staffs of other departments and outside sources. The sooner this is realized the better, for it is essential that such persons enjoy a period of thorough training.

It is unfortunate indeed that the selection of institutions for Army and Navy training programs is piecemeal. Some of the less well-equipped institutions, from the standpoint of both personnel and facilities, have been announced as on the approved list, while excellent institutions are still quite uncertain where they stand. This situation throws a heavy burden of responsibility upon the administrative officers and staff members of those colleges which are held in suspense. Apparently the Army and the Navy can not be expected to guarantee the use of an institution until a final decision is reached. In the meantime the college will have to depend on any indications that may be given by "approvals for inspection" and the attitude of inspection officers. This means that an institution must be its own judge as to whether or not it should hold its staff together until a "letter of intent" is issued. Unless a nucleus of experienced teachers is maintained, it will be difficult and perhaps impossible to revive a department. In some instances, it may be feasible to release staff members "on loan," subject to recall.

The best information that can be obtained indicates that, except for institutions that can not furnish the necessary housing and messing facilities, all normally good physics departments will be used and there are practically no departments from which teachers should be taken. It is to be hoped that departments fortunate enough to secure early contracts will not yield to the temptation to pirate staff members from other institutions. There is no good department of physics so small that the professor of physics should not attempt to remain at the post to hold things together, with the hope that some sort of training program may be secured or that he can maintain a civilian program of value to the war effort. All the better qualified departments are practically certain to receive contracts of one kind or another.

It is true that there will be a small, legitimate movement of physicists from one teaching position to another and it is to be hoped that readjustments within departments may release a considerable number for war research.

The Office of Scientific Personnel is ready to assist in any changes that will further the war effort and will welcome the registration of available persons, especially those who may be released for war research.

HOMER L. DODGE

DIRECTOR, OFFICE OF
SCIENTIFIC PERSONNEL,
NATIONAL RESEARCH COUNCIL

THE PRODUCTION OF THE MEAT, MILK AND EGGS TO WIN THE WAR AND THE PEACE

MEAT, milk and eggs are among those protective foods which are considered so essential for maintaining the health, stamina and morale of the armed forces and civilian populations of the United Nations. The United States has been called upon to serve as the food arsenal for democracy. While this country is one of the best in the world for livestock production, maximum use is not made of the knowledge developed by the research workers so that production is still somewhat inefficient and much loss occurs. Many of the losses from which the farmer suffers are insidious in nature and resemble more the work of sabotage than the direct annihilative result of warfare.

From the biological point of view it is not sufficient to merely ask for an expansion of production without providing suitable recommendations for handling those problems resulting from increasing the density of the animal population and to make provision for substituting adequate feeds and other products required for the animal population as a result of the changes brought about by the war. Production programs based upon the best existing available knowledge are currently being prepared for the guidance of farmers and breeders under the auspices of the Inter-Association Council on Animal Disease and Production.

This council is composed of the following representatives from the respective national associations: Dr. H. W. Jakeman, *chairman,* American Veterinary Medical Association; Dr. L. E. Card, Poultry Science Association; Dr. W. V. Lambert, American Society of Animal Production; Dr. G. E. Taylor, American Dairy Science Association; Dr. Mark Welsh, United States Live Stock Sanitary Association.

This council was formed as an outgrowth of an informal discussion held by a group of men whose interests were concerned with the activities of the associations mentioned above. The informal discussion was held on April 1, 1942, during the meetings of the Federation of American Societies for Experimental Biology. The scientists attending these meetings were pointing out the great need for improving the diet of the American public, and consequently those at the informal discussions recommended that official representatives be appointed from the associations for the development of coordinated programs, which would advise the farmer on the most practical methods of attaining the food production goals which he had been asked to reach.

Officially appointed representatives held their first meeting on May 11, 1942, in Chicago. They recommended that the Inter-Association Council prepare suitable production programs, utilizing the facts already well established, and that the National Research Council be requested to appoint a Committee on Animal Health for consideration of those critical problems which require further research before they can be suitably handled. Such a committee has been appointed by the National Research Council.

The report of the Inter-Association Council was duly accepted by the various organizations, and the council has proceeded in accordance with its instructions for the preparation of production programs. Outstanding consultants on the various classes of live stock have been appointed, and special programs are expected to be available in the near future. They will consist primarily of a series of recommendations which are designed to enable the farmer and breeder to most effectively produce the livestock and livestock products required of him.

H. W. JAKEMAN,
Chairman

SCIENTIFIC BOOKS

"FAMILY TREASURES"

Family Treasures. By DAVID D. WHITNEY. 299 pp. Illustrated. Jaques Cattell Press. 1942. $3.50.

A BIOLOGICAL teacher and investigator of long-established and high reputation has prepared a popular guide to heredity based upon observation of his own family and that of many of his students. Unlike most books on human genetics, stress is laid on normal, somatic and physiological traits rather than on pathological ones. As is very wise, the book deals prevailingly with facial features, since these are more accessible through photographs in successive generations of the same family.

An outstanding feature of this book in which it differs from all other books on human heredity is the abundance of photographic material secured and published in the 234 illustrations. Particularly striking is the large scale of many of the facial photographs that are reproduced, in many cases somewhat enlarged. This enlargement concentrates attention upon details which would otherwise be overlooked.

The book is also characterized by a comparative absence of quantitative materials such as are provided by careful measurements with various kinds of measuring apparatus. This will be regarded by many as a defect. On the other hand, the work is rendered the more readable by being qualitative rather than quantitative in its descriptions.

From the standpoint of the investigator in human genetics it may be stated that the author stresses too little the complicated inheritance of many human traits. Multiple factors are so widespread that some students have felt that a new approach to inheritance of human traits is best secured through a new quantitative method of approach. But here again the quantitative studies of this nature are decidedly esoteric and far beyond the scope of a book which is "written for amateurs in the study of human heredity and for those who are interested in personal inheritance of family traits." The book is well adapted to dispelling many of the myths surrounding some of the popular oppositions to heredity and it is also well adapted to the stimulation of other students of heredity to make further extensive studies.

For the purpose for which it is designed the book

seems admirably adapted. It is hoped that it will secure the widest possible circulation.

C. B. DAVENPORT

ENTOMOLOGY

General Entomology. By S. W. FROST. 9×6 inches. x+524 pp. Frontis., 406 illus. New York: McGraw-Hill Book Company, Inc. 1942. $4.00.

THIS book, which is a text for elementary college entomology, covers a wide field in a general manner, and stresses the study of insects in their native habitats. Its 23 chapters are devoted to the position of insects in the animal world; the origin and distribution of insects, using Wallace's 1876 figures to show distribution trends; the abundance and reproductive capacity of insects, as indicated by the prolificness of aphids, flies and some scale insects; beneficial and injurious insects, including poisonous ones and those transmitting human diseases; the different orders, with keys for their separation; metamorphosis; immature insects, with special consideration of various types of eggs, nymphs and pupae and their adaptations; insect morphology; color, including color changes, sexual coloration, varietal coloration, insect color perception, photogenic insects, etc.; sonification, using the cicada, crickets and grasshoppers as examples; insect behavior mostly from the view-point of tropotaxes; insect associations, including hibernating, protective, migrating, swarming and sleeping aggregations as well as social aggregations; solitary insects, their food and nesting habits; scavengers, predators and parasites; associations of plants and insects, including mutual associations, adaptations of flowers and insects, and insectivorous plants; leaf-mining insects; leaf-rolling insects; gall insects; boring insects; subterranean insects; aquatic insects; case-making insects; and cessation of activity, including diapause, suppressed development, sleep, death feigning and factors causing the death of insects.

Each chapter, which is a complete essay in itself, is accompanied by a bibliography of the more important papers in that field. In addition there is an appendix consisting of field keys to the immature forms (except eggs and pupae) of the Orders, keys to common groups of Coleopterous and Lepidopterous larvae, a table of the synonymy of Order names, a table showing schemes of the classification of orders from 1735 to 1937 and a summary of the important groups of leaf-mining and subterranean insects. An adequate index ends the volume. The illustrations are numerous and uniformly good.

Because of the enormous field covered by Professor Frost, the discussions are, of necessity, brief. Nevertheless, his summaries are adequate and sound and represent the matured and extensive knowledge of many years of experience and research. In addition, Professor Frost has incorporated in his book various topics not usually found in our text-books, such as Bryson's table for the identification of soil insects by characteristics of their burrows, discussions of the food habits of large groups of insects, of the fecula of insects, of the amounts of foliage consumed by certain species and of other important discoveries by entomologists. These facts, together with his presentation, make this volume an extremely interesting one and an ideal and stimulating introduction of the subject for college students.

HARRY B. WEISS

SPECIAL ARTICLES

CLOSE RELATION BETWEEN RUSSIAN SPRING-SUMMER ENCEPHALITIS AND LOUPING-ILL VIRUSES[1]

IN 1938 Russian scientists isolated and described a virus obtained from the brain tissue of fatal cases of encephalitis occurring in Russian woodsmen.[2] They placed their virus in the St. Louis-Japanese B encephalitis group on the basis of reactions in laboratory animals but then differentiated it sharply from St. Louis and related it slightly to Japanese B virus as a result of immunological tests.

The Russian virus sent to Dr. R. R. Parker in this country[3] was made available to us for study through the agency of the Commission on Neurotropic Virus Diseases of the United States Army and the cooperation of Drs. Dyer, Parker and Cox, of the U. S. Public Health Service.

We have found this strain of Russian virus to be similar to a strain of louping-ill virus, the causative agent of an encephalitis of sheep in Scotland[4] and possibly of Australian X disease of children.[5] The strain of louping-ill virus in our laboratory was obtained from Dr. T. M. Rivers in 1932, shortly after he had received it from Scotland.

Our observations on the Russian virus are briefly

[1] These investigations were aided through the Commission on Neurotropic Virus Diseases, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Division, Office of the Surgeon General, United States Army.

[2] E. N. Levkovich, A. K. Shubladze, M. P. Chumakov and V. D. Soloviev, *Arch. sc. biol.*, 52 (1): 162, 1938; A. A. Smorodintseff, *Arch. ges. Virusforsch.*, 1: 468, 1939–40.

[3] R. R. Parker, *Public Health Rep.*, 57: 1963, 1942.

[4] J. M. Alston and H. J. Gibson, *Brit. Jour. Exp. Path.*, 12: 82, 1931.

[5] J. B. Cleland, *Proc. Roy. Soc. Med.*, 12 (Sec. Path.): 33, 1918–19; A. Breinl, *Med. Jour. Australia*, 4: 454, 1917.

as follows: Rabbits and guinea pigs remained well following intracerebral inoculation with large doses. Mice, however, were highly susceptible to the virus whether injected by intracerebral, intraperitoneal or subcutaneous routes. Lesions in the brains of mice following intracerebral inoculation were similar to those of louping-ill and Japanese B encephalitis. Altogether these findings suggested that the Russian virus might be related to the Japanese B or louping-ill group.[6]

TABLE I

COMPLEMENT-FIXATION TESTS
MOUSE HYPERIMMUNE SERA

Serum	Antigen		
	Russian spring-summer encephalitis	Louping-ill	St. Louis encephalitis
Russian spring-summer encephalitis	1/64*	1/32	0
Louping-ill	1/32	1/64	0
St. Louis encephalitis	0	0	1/64

* Highest dilution of serum giving a 2+ or better fixation. The first dilution of serum was 1:2 in all cases.

Immunological studies comprised complement-fixation and serum-protection tests with hyperimmune and convalescent sera, as well as cross-resistance tests. Complement-fixation tests with hyperimmune sera showed no relation between Russian and any known central nervous system virus except that of louping-ill. In the case of the Russian and louping-ill viruses, however, there was cross-fixation nearly to titre (Table I). Similar crossing was obtained when the antigens were titrated against a constant amount of serum. Serum-neutralization tests with hyperimmune sera showed that the Russian serum, although prepared with difficulty, neutralized Russian and louping-ill viruses equally well, whereas the louping-ill serum, although easily prepared, neutralized the Russian virus only to part titre. Sera from three human convalescents were also tested. The first two cases survived what was presumably a laboratory infection with louping-ill[7] in 1933. The third survived an infection probably also contracted in the laboratory in

TABLE II

COMPLEMENT-FIXATION TESTS
HUMAN CONVALESCENT SERA

Serum	Antigen		
	Russian spring-summer encephalitis	Louping-ill	St. Louis encephalitis
Human No. 1	1/8*	1/8	0
Human No. 2	1/8	1/8	0
Human No. 3–I	1/16	1/16	0
Human No. 3–II	1/32	1/32	0

* Highest dilution of serum giving a 2+ or better fixation. The first tube in each case contained undiluted serum.

1942. Sera from these cases all fixed complement equally well in the presence of Russian or louping-ill antigen (Table II) but neutralized louping-ill somewhat better than Russian virus (Table III).

TABLE III

NEUTRALIZATION TESTS
HUMAN CONVALESCENT SERA

Serum	Neutralization index for:		
	Russian spring-summer encephalitis virus	Louping-ill virus	Japanese B encephalitis virus
Human No. 1	150	1500	−10
Human No. 2	10	500	−20
Human No. 3	150	500	− 1
Normal human control	1	1	1

Cross-resistance tests showed that mice vaccinated with non-virulent Russian virus were protected against at least 10,000,000 intraperitoneal lethal doses of Russian virus and 100,000 intraperitoneal lethal doses of louping-ill virus, and that mice vaccinated with non-virulent louping-ill virus were protected against at least 100,000 intraperitoneal lethal doses of both louping-ill and Russian viruses (Table IV).

TABLE IV

CROSS-PROTECTION TEST

MICE VACCINATED WITH EITHER RUSSIAN SPRING-SUMMER ENCEPHALITIS, LOUPING-ILL OR WESTERN EQUINE ENCEPHALOMYELITIS FORMOLIZED, AVIRULENT, MOUSE BRAIN EMULSIONS. TESTED INTRAPERITONEALLY FOR IMMUNITY AGAINST RUSSIAN SPRING-SUMMER ENCEPHALITIS AND LOUPING-ILL VIRUSES

Vaccine (0.25 cc × 2) subcutaneously	Fate of mice following intraperitoneal injection of 0.5 cc of virus in dilutions:															
	Russian spring-summer encephalitis virus									Louping-ill virus						
	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}
Russian spring-summer virus	2/5*	1/5	1/5	0/5	0/5	0/5				3/6	0/5	1/5	0/5	0/5	0/5	
Louping-ill virus	5/5	4/5	2/5	2/5	0/5	0/5	0/5			0/5	0/5	1/5	0/5	0/5	0/5	
Western equine encephalomyelitis virus			5/5	5/5	5/5	5/5	5/5					3/5	5/5	4/5	0/4	
No vaccine—controls			5/5	5/5	5/5	5/5	5/5	5/5	0/5		5/5	4/5	5/5	3/5	3/5	3/5

*2/5 = Two mice out of five died following inoculation.

Because of these findings we regard the specimens

[6] Leslie T. Webster, *Jour. Am. Med. Asn.*, 116: 2840, 1941.

[7] Thomas M. Rivers and Francis F. Schwentker, *Jour. Exp. Med.*, 59: 669, 1934.

of Russian and louping-ill viruses as received in our laboratory as similar. Final proof of the identity of these two agents awaits the testing of fresh specimens of virus obtained from Russia and Scotland. Meanwhile we call attention to the possibility that the tick-borne spring-summer virus encephalitis of man in the timber country of Russia and the tick-borne virus encephalitis of sheep in Scotland may be caused by one and the same infectious agent.

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L. T. WEBSTER
THE LABORATORIES OF THE ROCKEFELLER
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN INEXPENSIVE DISPOSABLE FILTER FOR BLOOD AND PLASMA TRANSFUSIONS

ACCUMULATION of fibrin and gelatinous material in stored blood and plasma is commonplace despite the use of sufficient sodium citrate solution. The macroparticles become more numerous with increased age of the stored product and are a serious hazard in the administration of blood and plasma.

There is universal agreement among reputable authorities that filtration of blood and plasma must be carried out previous to intravenous administration, and yet an entirely satisfactory filter does not exist. Metal screens in common use are expensive, difficult to clean and are either too coarse to retain the undesirable material or else they are so fine that they become clogged easily. The use of cotton gauze should be condemned, for cotton fibers may be liberated into the filtered product and the open method usually employed allows air contamination with bacteria to take place. Other methods which have been proposed are impractical from the standpoint of breakage and difficulty encountered in cleaning the apparatus.

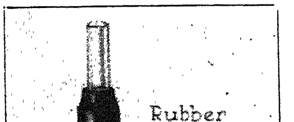

FIG. 1

The essential problem then is the need for a filtering mechanism which will: (1) Yield a filtrate free of fibrin or gelatinous accumulations; (2) not clog or leak while in use; (3) allow continuous filtration during administration of the blood and plasma; (4) allow filtration under aseptic conditions; (5) eliminate the uncertain and laborious cleaning procedures; (6) be relatively inexpensive.

A simple apparatus which fulfils these requirements reasonably well is illustrated in Fig. 1. It consists of a cone-shaped viscose rayon sheer cloth bag made by sewing together two triangular pieces of the material; each piece having a base of 4 inches and an altitude of 8 inches. This allows a large filtering surface and eliminates the possibility of clogging. The bag is attached to a short glass tube by means of a $\frac{1}{2}$-inch piece of rubber tubing and then enclosed in an 8-inch length of $1\frac{5}{8}$-inch viscose sausage casing. The casing is gathered at either end around glass tubing and attached by means of $\frac{3}{4}$-inch pieces of rubber tubing which act as tight-fitting rubber bands. The apparatus may be wrapped separately and autoclaved or attached directly to the transfusion set just above a Murphy drip and sterilized with the set.

Chief advantages of the filter are its efficient and rapid filtering action without clogging made possible by the large filtering area. It does not leak. Its construction is simple and inexpensive so that it need be used but once and then discarded. Its lightness, compactness and disposability are features especially suitable to military conditions.

The cost of labor and materials required to make an entirely new filter for each transfusion is less than the cost of labor and breakage involved in cleaning the metal or glass filters now in common use. The problem of reactions attributed to unclean filters is eliminated. In actual use at the Research and Educational Hospitals of the University of Illinois it is preferred to other types of filters.

MILAN NOVAK
COLLEGES OF MEDICINE,
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BOOKS RECEIVED

DACK, G. M. *Food Poisoning.* Pp. xi + 138. University of Chicago Press. $2.00.

LUSH, JAY L. *Animal Breeding Plans.* Illustrated. Pp. viii + 437. The Iowa State College Press. $3.50.

MORGAN, W. W., PHILIP C. KEENAN and EDITH KELLMAN. *An Atlas of Stellar Spectra.* With an Outline of Spectral Classification. Illustrated. Pp. 35. 55 Plates. University of Chicago Press. $10.00.

ST. JOHN, ANCEL and HERBERT R. ISENBURGER. *Industrial Radiology.* Illustrated. Pp. ix + 298. John Wiley. $4.00.

SCIENCE NEWS

Science Service, Washington, D. C.

EINSTEIN'S THEORY OF GRAVITATION

Dr. George D. Birkhoff, professor of mathematics at Harvard University, before a scientific audience at the University of Cincinnati in a lecture which is also to be delivered before local chapters of the honor society Sigma Xi throughout the country, stated that Einstein's theory of gravitation, although it provides a satisfactory explanation of gravitational phenomena is "essentially unworkable." Dr. Birkhoff pointed out that all the newer theories of quantum physics are found inadequate as they can not be fitted into a satisfactory explanation of the universe.

To the physicist, this larger view of nature seems unnecessary. It is sufficient if he can by means of his theory calculate results that can be verified by scientific experiment. The mathematician, on the other hand, wants to understand how each theory fits into his whole knowledge of nature. When the theories were not developed from the simple aspects of nature—objects, sequences of events, or geometric forms that can be recognized—but have been created by the human mind, then the mathematician wants to be able to build a physical model to fit the theory.

It is not possible, according to Professor Birkhoff, to build any such tangible model from the modern theories of quantum mechanics. It may be true, he said, in some mystical sense that God thinks multi-dimensionally whereas men can only think in a series of logical steps along a line. We need a satisfactory mathematical theory to remedy our deficiency in this respect.

The way mathematical concepts and theories have been developed from simple experiences of nature was described: "A child puts its hand too near the fire and is burned, and thereafter remembers that this A (touching fire) will bring about this B (pain and burn). The chain of association fixed in his memory is essentially of the propositional type 'A implies B.' He has learned a physical fact!" This is the basis of logic. "The boy playing with a pile of pebbles on the seashore is dealing with a universe of distinguishable objects just as was the shepherd in ancient times who counted his flock by means of stones. In this simple process of one-to-one correspondence lies a basic difference between man and all other animals." This is the basis for the concept of number.

Geometry arises from the idealization of physical bodies which are taken to be rigid forms and is practiced by the use of such simple "rigid bodies" as the ruler and protractor.

With only these three examples before them, mathematicians have set out to generalize and to modify. More recently they have added the concepts of time and a system of forces. From these have been built the framework of the universe of space and time.

FOOD PRODUCTION IN FRENCH NORTH AFRICA

Agricultural North Africa may this year produce foods to take care of its native population and to feed the Allied troops in the area if crops can be planted during the next month or two. Seeds, fertilizers, and farm machinery and repair parts are the essential needs. Irrigation systems must be restored. Drainage and soil improvement are necessary. Fuel for tractors and farm trucks must be supplied.

American and British food in large quantities is now being shipped to French Morocco, Algeria and Tunisia. The Allied troops, American, British and French, must be fed. The starving civilian population must have food if full cooperation is to be obtained. Considerably over a million tons of grains, meats and other foodstuffs were taken out of these countries in 1941 to feed the Axis, including Rommel's forces in Africa. Large quantities were taken again last year. Little was left for the home people.

In the past these French North Africa countries produced much more food than was needed locally. During the four-year period beginning in 1934 they exported each year approximately 2,500,000 tons of food and nearly 1,500,000 tons of wine. Wheat, barley, oats and corn made up the principal grain exports. The meat was mutton and lamb. Potatoes, dry legumes, fresh vegetables, oranges and olive oil were the other leading exports.

The agricultural lands of North Africa lie between the Mediterranean and the northern Sahara desert. Most of it is rough, hilly and mountainous. It resembles in topography and climate much of central California. Included is timber land, farm land, and grazing land on which sheep and goats are the common stock. Oranges, grapes and olives are raised on the coastal lands. The grains are grown along the rivers and on the plateaus in the hilly areas.

Small, primitive farms and large up-to-date mechanized farms lie side by side. These large farms use machinery similar to that used in America, and it is from them that surplus crops may be expected if the necessary help is provided.

A food production program for French North Africa has been set up by the United States, Great Britain and local authorities, working together. The program, if successful, will produce enough food to feed all civilians and troops in the area, and perhaps supply Allied forces in southern Europe. It will save American food for Americans and the starving peoples in Nazi-conquered countries. Much shipping space will also be saved.

The associate director of the Office of War Information, Milton S. Eisenhower, has recently returned from a trip to these countries, where he studied the program and learned conditions at first hand. He was long associated with the U. S. Department of Agriculture. He sees no reason why French North Africa can not produce this year crops equal to those produced in pre-war days if the necessary assistance is given. He believes that in future years much larger crops can be produced by extending irrigation systems, bringing new lands into production and adopting better farming methods. French North

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DETERMINISM AND RESPONSIBILITY[1]

By Dr. HENRY NORRIS RUSSELL

PRINCETON UNIVERSITY OBSERVATORY

THERE is an old saying concerning the Christian ministry. "Every man must be an Arminian when he preaches, and a Calvinist when he prays." That is, in the first case he must emphasize free-will; and in the second, divine providence. This is far more than an epigram; it is an effective statement of an intellectual difficulty which besets religion, philosophy and science alike. Even the most case-hardened mechanist of the old nineteenth-century school had no qualms about asking his neighbor at table to pass the butter.

It is bold to attempt even a partial resolution of this ancient antinomy; but I am convinced that it may be very considerably clarified with the aid of concepts derived from physical science. In a round-table discussion, voices of protest would rise here. "Have you forgotten Heisenberg?" "Has not modern physics abandoned determinism, and committed itself to a principle of indeterminacy?"

Some ground must be cleared here before the discussion can proceed. It is not only in past centuries that mischief has been done by the unfortunate choice of a name. If the great physicist who discovered the "uncertainty principle" had only called it the "Principle of limited measurability" (as Max Born did a few years later) we might have been spared a great part of the "awful outbreak of intellectual licentiousness" which Bridgman all too truly foresaw among the half-informed.

The principle is of the type which Whittaker has recently called Postulates of Impotence.[2] Like New-

[1] A paper presented at the Third Conference on Science, Philosophy and Religion, New York, August 28, 1942.

ton's postulate, which amounted to denying the possibility of finding any unique state of absolute rest in nature, or Einstein's, which makes a similar denial regarding absolute motion, it has clarified so many difficult problems that it has won unanimous acceptance among physicists. Simply put, it denies the possibility of measuring the position and motion of any particle simultaneously and with perfect accuracy. The better we do with one, the less we must be contented with for the other.

The difficulty arises from the fact that the means of measurement themselves can not be refined to absolute perfection, because nature is not fine-grained enough. Matter, electricity and radiant energy all come in discrete packets—atoms, electrons, quanta—and no experiment can be made upon a single one of them except by hitting it with another, and thereby seriously disturbing the situation which we desired to study and measure.

There are many things which we physicists would dearly love to find out that nature won't let us—for example, what was the difference between the atom of radium which blew up last second and its neighbor, which will go on for centuries before undergoing the inevitable, but long-delayed, change.

We have no present hope of finding out why one atom disintegrates and not the other; but I, for one, am convinced that this does not justify us in saying that there is no reason. We must be agnostic about the question, but may not proclaim a negative dogma. The most that we can do is to say that, since no experiment made with the aid of anything known to exist in nature gives any hope of answering the question, it is "not physics."

One conclusion is clear. The nineteenth-century image of a vast, though finite, intelligence, which could determine at a given instant the exact positions and velocities of every particle in a (finite) universe, and their laws of interaction, and thus be enabled to predict with absolute accuracy the whole future history of the universe, is also "not physics." Such a perfectly detailed prediction of phenomena, even on the atomic level, is out of the picture.

Must we then be indeterminists? The only one I ever heard of was described to me by Dr. Watson, of the American University at Cairo. Visiting a date-grove, he asked his Mohammedan host, "What is the average life of a palm-tree?" and was answered "That will be known only after the Great Day of Judgment." His request for elucidation surprised the Moslem. "Surely you Christians believe, as we do, that all things are determined by Allah's Will." "Truly." "Then, when He says to a date-stone 'Spring up' a palm grows. When He says to that tree 'Die' it dies. Only when the Great Day is over, and the affairs of earth are ended, will it be possible to know what average age Allah, in His wisdom, has assigned to a palm-tree." Here is the true Indeterminist—an educated man, believing in an almighty, just and compassionate, though somewhat arbitrary, God—but not in the law of averages.

Hardly any philosophy could be more at variance with modern physics. There is very strong evidence that—though the individual quantum-jump is unpredictable, the distribution of the results of large numbers of them is strictly governed by the laws of probability. The average results for successive groups of the same number of cases, though not identical, differ from one another, and from a general mean value, by small percentages, which grow steadily smaller as the number of cases in a group is increased. In the rare instances where single quantized events produce directly observable results, fluctuations in space and time are conspicuous—as may be seen by looking at the dial of a "radium watch" in the dark with a hand-lens. But, even here the apparent disorder of the unequal intervals has an underlying statistical order. Not only is the average value of the successive intervals substantially the same, for large groups, but the percentages of individual intervals which are (say) less than half, or more than twice the general mean, tend, for increasingly large samples, to definite values, predictable on well-known mathematical principles.

Most directly observable phenomena depend upon a number of atomic events which runs far beyond the possibility of counting in mere billions and trillions. In consequence, the statistical fluctuations in the averages of successive similar trials shrink below the limits of the best measurements and individual uncertainty is transformed into practical certainty. Strictly speaking, this is only a high probability; but the probability can be calculated and is so terrifically high that it is more impressive than any dogmatic assertion of certainty.

Take a very simple case—a glass globe containing 100 small smooth balls, just alike except that 50 of them are white and 50 yellow. If the globe is thoroughly shaken and set down, the balls will settle into a circular patch at the bottom. It might happen, by pure chance, that all the white balls fell into the north half of this patch, and all the yellow ones into the south half; but the probability of this is 2^{-50}, approximately one chance in 1,126,000,000,000,000. The thing might happen; but it would be throwing away money to bet one cent against the whole cost of the war that it would.

Before I can develop my main argument, I must ask you to go a bit farther with me into this strange territory, and consider the meaning of what are called "statistical properties."

[2] E. T. Whittaker, *Proc. Roy. Soc. Edinburgh*, 61: 168, 1942.

A classic illustration is the pressure of a gas. For several decades, in the actual growth of the science—and, for a few weeks, in an introductory course in physics to-day—a gas was, and is, regarded as an elastic fluid, filling uniformly the whole space between the walls by which it is confined, and exerting upon these walls a pressure (a force per unit of area) which is continuous—the same on all equal areas, however small, and at all times (so long, of course, as the general conditions are not changed).

Before the student's first year in physics is over he learns more. The gas is no longer regarded as a continuous medium, but as an assemblage of a vast number of molecules, flying about in every direction and rebounding from one another and from the walls. The impacts on the walls produce the pressure. Over sufficiently small areas of wall, and small intervals of time, they are not even roughly uniform; but for areas large enough, and times long enough to use in making ordinary measurements, they are so numerous that they average out to practically the same result every time.

Now the mathematical picture of the uniform continuous pressure is a very great deal simpler to work with than the innumerable individual impacts. Under ordinary engineering conditions the averaging-out process is statistically good to one part in a million or better. Consequently, the engineer adopts the simple generalized image of pressure with entire security that the calculations, based on it, will be as accurate as he ever needs them to be. From his standpoint, gas-pressure is an obvious reality.

But the physicist, or the technician, who works with a "high" vacuum, is in a very different position. He can make the number of molecules in his apparatus so small that the averaging-out process becomes trustworthy to only one part in a thousand, then one in a hundred, one in ten—and finally not at all. He has to think about the individual molecules and atoms if he is to make any sense of his observations—and when he does he gets results of practical value such as the tubes used in every radio set.

It can now be understood why a statistical property has some remarkable characteristics. (1) It is a creation of the human imagination designed to describe the relations of observed phenomena. (2) It is a simplified description of an excessively complex underlying situation. (3) It is of great theoretical and practical utility, both in science and technology. (4) Over a wide range of conditions it enables us to predict the results of experiment more accurately than we can hope to measure them. (5) Beyond the limits of this range, it gradually disagrees more and more with the facts.

Practically all the physical properties which we ordinarily attribute to material bodies, such as density, temperature, elasticity or surface tension, are statistical in nature. It is these properties which are connected by the familiar empirical "laws of nature" such as the laws of perfect gases, or those which govern the similar, but more complicated, behavior of steam. These laws express statistical relations, and predictions from them possess, not certainty, but a *statistical probability* which under ordinary circumstances comes to the same thing.

With these foundations laid, we may approach the problem of human conduct and responsibility.

Man is in part, at least, a physico-chemical system of extreme complexity. No attempt will be made here to discuss the question whether he is also, and essentially, something more and "higher"; but it will be profitable to explore some of the consequences of the hypothesis that man is entirely a physico-chemical system. This means that, given sufficient knowledge of the system and sufficient technical skill in analysis, it would be possible, by the methods of science, to deduce from the structure of the system the properties of human beings—whether physiological, psychological or social—unless, indeed, the investigation was blocked by the appearance of another postulate of impotence.

I am not asking you now to accept this hypothesis, but to consider its consequences, assuming that no impotence intervenes. Two conclusions may safely be drawn.

(1) The properties of mankind, predicted by such a theory, must coincide with the actual properties as revealed by empirical observation. New relationships among these might be opened up and old descriptive formulae superseded; but, if the theory predicted properties different from those which men actually have, it would be a bad theory, and the possibility of the physico-chemical explanation would be "not proven."

(2) The properties predicted by a successful analysis would be of the nature of statistical properties.

Among the most obvious and important properties of man is self-determination. Whether we consider the behavior of others or our own conscious experience, a great number of varied observational data may be reduced to order and empirically "explained" on the hypothesis that the normal human individual is a conscious person, possessing (within limits) intelligence and memory, and with a very considerable degree of control over his words and actions. We all act on these postulates every day—almost every hour—and it would be practically impossible to live through a day of normal human relations without acting on them. My old friend, Professor E. G. Conklin, tells of a conversation he once had with Jacques Loeb. "After he had vigorously denied the reality or possibility of human freedom, he saw his little son running down the steps with a large open

clasp-knife in his hand. At once he shouted, 'Bobby, close that knife. You might fall on it.' I said 'Now, Loeb, practice your philosophy' and in reply he merely winked one eye at me."[3]

It is an immediate consequence of these postulates that the normal individual may reasonably be held responsible for his voluntary actions. Without this principle, organized society could hardly exist.

This naive statement of the situation suffices to introduce the main point of my argument. If an interpretation of the human individual as a purely statistical system is assumed to be possible, then the empirical characteristics of consciousness, memory, reason, self-determination and responsibility must *ex hypothesi* appear as statistical properties of this system—or at least be capable of precise correlation with such statistical properties. Otherwise, the thing which the system represented would not be human.

If freedom and responsibility were statistical properties, we might expect them to have the distinctive earmarks of such properties. They are undoubtedly concepts of empirical origin and of very great theoretical and practical utility. Whether they are simplified descriptions of a complex underlying situation is not at present determinable beyond debate—we know too little of the nature of man.

But it is generally recognized that freedom and responsibility have their limitations. Some of these are purely intellectual—we are not free to imagine a polyhedron with plane faces and seven edges—and here the limitation is absolute, for we can prove that no such configuration exists.

But the responsibility to which a man might reasonably, or, if you will, justly, be held by a precise analysis, varies with the knowledge, intellectual capacity and often with the physical strength of the individual and, for the same individual, must take into account changes in health, fatigue, anxiety and a hundred other things. I owe again to Conklin the suggestion that responsibility fully assessed to the limit of its ethical significance is a continuously varying quantity. All men are equally responsible before the law—yes, because the portion of a man's whole range of moral responsibility to which the law fairly may—or actually can—hold him is so small a fraction of the whole that individuals who fall below this level may be regarded as defective. The law itself recognizes this exception.

At the limits of the field of responsibility we do not find a sharp boundary separating complete and absolute responsibility from its utter absence. There is, rather, a gradual falling off with changing circumstances—as is tragically illustrated by the progress of degenerative physical or mental disease.

More might be said if time permitted; but it is already evident that responsibility possesses the distinctive ear-marks of a statistical property, whether it is one or not—and the evidence in the case of freedom is similar.

I may now at last make bold to announce my principal thesis: The mechanistic hypothesis of the nature of man (in the statistical sense described above) is not an enemy, but an ally, of morals and religion.

I do not contend that this hypothesis is scientifically established—though the evidence in its favor appears to me to be strong;—and I leave its general philosophical implications to those versed in this discipline. But it goes a long way toward resolving the ancient dilemma of fate or freedom.

This takes its sharpest form when expressed in theological symbols—predestination versus free-will. In this presentation, indeed, it appears hopeless—an antithesis between human wills and a divine will, conceived as similar in nature, though with infinite wisdom and power behind it.

But, on the mechanistic hypothesis, the determinism enters through the structure of the underlying system, while freedom and responsibility are statistical properties of the assemblage, man. The antagonism is no longer acute, for one of the most distinctive features of the statistical properties of a system as a whole is that they can not be found in the characteristics of the individual particles which compose it. On the lower level of interpretation the statistical properties are not present. But on the higher level of integration they are the important ones, and suffice, in theory and practice, for the discussion and study of the system. Pressure, temperature, elasticity, and the like, are realities for the engineer. The physicist may use either terminology, according to the nature of his particular investigation; but he must be careful not to mix up concepts belonging to two different levels. It would be fatal, for example, to think of electrons shot out into a gas as if they were moving through a continuous medium; and to speak of the pressure or temperature of a single molecule in a gas is meaningless.

When considering the social, ethical, esthetic and religious relations of men, we start automatically on the higher level, and consciousness, reason, personality, freedom and responsibility are the concepts relevant to studies on this level. These studies are difficult enough, Heaven knows; but this is no reason why we should bedevil ourselves by introducing at one point, and at this point only, deterministic concepts belonging to a different level of interpretation.

The trouble comes from introducing determinism and rejecting freedom and responsibility while retaining other concepts belonging to the higher level, such as consciousness and personality. It is imaginable

[3] *The Rice Institute Pamphlet,* 28: 218, 1941.

that to some vast Intellect, which saw through the desperate complexity of our nature, responsibility and freedom would be replaced by deterministic concepts, intricate beyond our very imagining. But there is every reason to suppose that personality and consciousness would also be replaced by similar unimaginables. To such an Intellect men might not appear to be persons either. Least of all would they be conscious automata.

The answer to the question, Which is the reality and which the illusion?—or, better, Which seems to be the illusion, and which the reality?—depends on the direction from which the problem is approached. To our hypothetical Intellect, the underlying complex would be the more real; but we, who approach things from the surface, see reality in the concepts that lie nearest us. These have value and importance to us, not because they are ultimate—if there be any ultimates—but because they are proximate. We needs must act as if they were real, and we are justified in doing so. Do you remember Kim and the Red Lama in the Himalayas? "Look and know illusion, *chela!* These are the true Hills!"

It is, of course, still hypothetical that such an interpretation of humanity is possible at all. But we know that there is a maze of subordinate levels—atomic, molecular, colloidal, cellular, physiological, psychical, and perhaps more—through which the way would be exceedingly difficult to follow, even if it were communicated to us.

Why, then, should we vex ourselves with such fine-drawn speculations? There are two strong reasons. First, the evidence in favor of statistical determinism in physical phenomena is overwhelming; and there is a great weight of physiological and psychological data which support the belief that we ourselves are not exempt.

The effects of certain drugs, and of some diseases, upon the higher aspects of personality provide the most appalling evidence. In a lighter vein, but provocative of earnest thought, is an old quip, from the days of Lister's medical teaching at Edinburgh: "No one ever died a triumphant death of trouble below the diaphragm."

These are but glimpses of a mass of evidence which puts the mechanistic hypothesis very seriously in court.

But the insistent problem, in times like these, is religious. There is no scientific difficulty in the belief that God, if He exists, controls the universe completely. Postulates of impotence need not be made concerning the Deity. It is hard to believe that a morally perfect God controls the world in which we struggle. But if we deny this—if God is not all-powerful—if the evil wills of "the rulers of the darkness of this world" are outside His control, then the victims of oppression are indeed of all men most miserable, and there is no ultimate security anywhere. If we have any religion at all, we will pray in these days—and it is to God Almighty that we must pray.

This faith—that God knows why He made the world this way, though we do not—has supported those who "subdued kingdoms, wrought righteousness . . . turned to flight the armies of the aliens." We need it desperately to-day, and we need equally faith in freedom.

May we not have both, and be spared one more chapter of the weary history of the warfare of science and theology, if we accept, tentatively at least, a mechanistic but statistical hypothesis of our own nature? I have tried to show that this involves no abandonment of belief in responsibility or freedom, and in another place[4] and at length, I have argued that it is fully consistent with belief in personal immortality. So far as I can see, the validity of intellectual and moral values is not impaired.

We have indeed to make one sacrifice; we will no longer be inclined to think of ourselves as irreducible spiritual units possessing some sort of ultimate reality independent of all else but God. But this hurts only our pride—and is likely to be good for us.

[4] "Fate and Freedom," Yale University Press.

THE NEW YORK ZOOLOGICAL SOCIETY[1]

By Dr. HENRY FAIRFIELD OSBORN

Members and Friends of the Zoological Society:

YOU come here each year for better reasons than hearing a long formal, detailed summary of the past year's activities. This will find its proper place in the printed Annual Report to be submitted to you at a later date.

The past year, however, has been an extraordinary year—a year of war. I feel therefore that comments should be made to you as to the situation of the Society in wartimes; that I should touch upon two or three of the major highlights of the year just ended—also speak briefly of the future.

The outstanding fact is that the activities for which this institution is responsible appear to mean as much to the public in days of war as they do in days of peace. Consequently, we have undertaken to maintain all our normal activities throughout the past year not

[1] Address at the Annual Members' Meeting of the New York Zoological Society, on January 12, 1943.

only in the operation of the Zoological Park but in the fields of education and research. Naturally, many obstacles have had to be overcome and many more await us, but we are determined to do everything in our power to continue to maintain these activities for the duration. Our endorsement and encouragement comes from the public itself—a visible and powerful growing public interest, the limits of which, I believe, we do not ourselves begin to measure.

Our scientific staff has been able to assist directly in a number of ways in the war effort, especially in the fields of marine intelligence and in medical problems. Forty-three members of our organization, including eleven trustees, are absent on military duty.

I will touch briefly on two or three of the highlights of the past year. The new farm exhibit has proved even more popular than we could have anticipated. More animals were taken out from behind the bars this last summer (the elephants and rhinoceroses) and interior improvements, notably those to the Bird House, were completed in December. It will of course not be possible to make improvements of any importance during this year, although a large number of minor betterments will be carried out.

In passing—we will open in April an event of an entirely new type. Mr. Liers is on our program to-night and he and his friends, the otters, will be with us for the season, giving a number of public showings every day. We believe that through these the public will gain a better understanding of the minds and manners of animals. Mr. Liers is not an animal trainer. He reasons with animals and lets them reason with him.

One field expedition was carried out—that under Dr. Beebe to Venezuela. We feel a debt of gratitude for the financial support given to this work by the Committee for Inter-American Cultural Relations, and also the generous arrangements made for Dr. Beebe and his staff at Caripito by the officials and organization of the Standard Oil Companies here and in Venezuela.

As to finances, we have no major complaint. We ended the year within our earned income. Somewhat surprisingly, considering war demands, the Society has received cash donations during the past year slightly in excess of $50,000. We have not thought it timely to enter into a general campaign for capital funds. Allow me, nevertheless, to remind you that this institution greatly needs funds for the fulfilment of its ultimate destinies in education, in research and in public service. It is not my business to suggest to you when and how to give!

As to the future, the Zoological Society is scheduled to receive a fund in excess of $3,000,000 under the terms of the Post War Program, as publicly announced by the Mayor on April 24, 1942. This will provide for the further modernization and development of the Zoological Park—the initial steps for such a program having been taken, you will recall, in 1939 with the drawing of plans for the African Plains Exhibit—and the building of a new Aquarium. In regard to the latter, we now have the opportunity of planning for an institution that will really do justice to the miracle of the life of the rivers, the lakes and the great oceans of this world. There is now available a plan and design fund of $60,000, of which the City has provided $40,000 and the Society $20,000. This year it is expected that an equivalent fund will become available from the same sources. Plans for both institutions are therefore now being put into the blueprint stage. (You can see, after this meeting in the exhibit corridor, projections of both of these major projects.)

What other destinies are there? Certainly the realization, we hope, of that most compelling and important idea—the establishment of a research center in the Zoological Park for the study of animal diseases in their relation to human disease problems. Sometime, somehow this must be accomplished. We further aim to create a dynamic and expressive conservation exhibit—an exhibit so designed that it will vividly carry to the public at large the message of the conservation of our natural resources. Our objectives include also the further extension of our educational work and of the research work which leads so definitely to the advancement of human knowledge.

I must not overstay my time. The other day, our guest speaker to-night sent me a quotation from a chemist—none other than Dr. Eliot, that great educational leader, late president of Harvard University. It runs as follows:

> The human race has more and greater benefits to expect from the successful cultivation of the sciences which deal with living things than from all the other sciences put together.

It is with such thoughts, such potentialities, such objectives in mind that this institution calls upon us for the best of our thoughts and of our energies.

OBITUARY

STEPHEN WALTER RANSON

1880–1942

Two days after he had reached his sixty-second birthday, Stephen Walter Ranson, professor of neurology and director of the Neurological Institute at the Northwestern University Medical School, died of coronary thrombosis on August 30, 1942. His wife, Tessie, and three children, Captain Stephen W. Ran-

son, Mrs. Margaret Jane Lacy and Miss Mary Elizabeth Ranson, survive him.

Dr. Ranson was born at Dodge Center, Minnesota, on August 28, 1880, the son of Dr. Stephen William and Mary Elizabeth Foster Ranson. After finishing Dodge Center high school in three years, he entered the University of Minnesota in 1898. Here he came under the influence of Professor J. B. Johnston, who stimulated in him an interest in the nervous system. At the end of his third year, he transferred to the University of Chicago. In 1902, he started graduate work at the University of Chicago, after receiving the A.B. degree from the University of Minnesota. He worked under the supervision of the late Professor H. H. Donaldson and received an M.S. degree in 1903 and the Ph.D. degree in 1905. His dissertation was entitled "Retrograde Degeneration in the Spinal Nerves." While a graduate student, he went to the St. Louis University School of Medicine and helped the late Professor A. C. Eycleshymer with the work in the Department of Anatomy there for part of the year of 1904. He served as a fellow in neurology at Chicago in 1904–1906 and was awarded the M.D. degree at the Rush Medical College in 1907. He completed a year's internship at the Cook County Hospital and had planned to establish a practice in Chicago. However, he was induced to take an appointment in 1908 as associate in anatomy at the Northwestern University Medical School by Dr. Arthur W. Meyer, who was then head of the department there. When Dr. Meyer left for Stanford the following year, Ranson accepted an appointment as assistant professor and acting head of the department. On August 18, 1909, he married Miss Tessie Grier Rowland, of Oak Park, Illinois, and their family circle was a happy and hospitable one. In 1910 he became associate professor and then in 1912 professor and head of the department of anatomy at Northwestern, where he served for the subsequent twelve years. He spent the year of 1910–11 at Freiburg in Professor Wiedersheim's laboratory.

In 1924, he went to the Washington University School of Medicine in St. Louis to become professor of neuroanatomy and head of the department of neuroanatomy and histology. He was extremely happy with this opportunity, which offered him a reduced teaching load and excellent facilities for research. However, he decided to return to the Northwestern University Medical School on the first of February, 1928, to become professor of neurology and the first director of the newly formed Neurological Institute there. He remained at Northwestern the rest of his life, where he devoted himself to building one of the most productive schools of neurology that has ever existed. Since 1929, the work of the institute has been collected in an annual volume and these volumes contain a formidable array of important contributions.

His own research is recorded in a bibliography of some 205 titles[1] and gives expression to his interest in the form and function of the mammalian system. He was interested throughout his life in the components of the peripheral cerebrospinal and the visceral nervous systems. His demonstration of unmyelinated nerve fibers as early as 1909 was given additional proof by his introduction of the pyridine silver technique in 1914, an important modification of one of Cajal's. After he found unmyelinated fibers in large numbers in sensory nerves, he devised experiments to show that they mediate pain sensation. His later experiments and those with the cathode ray oscillographic analyses such as made by Erlanger, Gasser, Bishop and others have supported his earlier work. Because he recognized unmyelinated fibers, his histological analyses of the peripheral visceral nervous system were much more complete than previous ones. His work on peripheral and central visceral afferent pathways and vasomotor centers in the medulla oblongata is included in his review on "Afferent Paths for Visceral Reflexes" in the first volume of *Physiological Reviews*.

For a period of years, he worked on the mechanisms involved in postural contractions and a study of postural reflexes. Ranson and his colleagues first became interested in the hypothalamic region for its significance in somatic motor integrations, for the study of which he introduced the Horsley-Clarke stereotoxic apparatus into his laboratory in 1930.

Later, he directed the attention of his laboratory toward the analysis of visceral responses elicited by stimulations in this region and of symptoms arising from lesions accurately placed by electrolysis. He and his co-workers investigated such problems as the significance of the hypothalamus and hypophysis in water exchange and the syndrome of diabetes insipilus, and of the hypothalamus to temperature regulation, obesity, sexual function, emotional expression, catalepsy and other abnormal conditions. The corpus striatum occupied much of his attention at the last.

His later work was reviewed in the following lectures: Weir Mitchell Oration (1934), Harvey Lecture (1936), the Dunham Lectures (1940) and Hughlings Jackson Lecture (1941). The volume of the Association for Research in Nervous and Mental Disease, "The Hypothalamus and Central Levels of Autonomic Function" (1940), was dedicated to him.

In addition to these contributions in the experimental field, Ranson was the author of the text-book, "The Anatomy of the Nervous System," the first edi-

[1] This bibliography has been published by H. W. Magoun, *Quart. Bull. of Northwestern Medical School*, Vol. 16, pp. 304–310, 1942.

tion of which appeared in 1920 and just before his death he had completed the seventh edition. This textbook has been an important factor in the development of neuroanatomy in a superior fashion in the United States. He was extremely conscientious as a teacher and his kindly and sympathetic manner will be remembered by many a student. On his return to Northwestern in 1928, he gave up undergraduate teaching.

Into the work of his laboratory, he attracted many students, both from this country and abroad. He stimulated teamwork, an intense interest in experimental work and the utmost loyalty. He has trained men who are now in teaching posts in anatomy and physiology in various institutions, and there are many in clinical medicine who spent time with him. His enthusiasm was infectious and his training rigid and demanding.

He was a trained morphologist with strong interests in physiological significance. He had a keen appreciation for the implications of his work to clinical neurology, but he did not swerve from his objectives in fundamental problems of morphology and physiology.

He was a fellow of the American Association for the Advancement of Science, and a member of the National Academy of Sciences, the American Neurological Association, the American Physiological Society and the American Association of Anatomists, of which he was president from 1938–40. He served for a number of years on the Committee on Nomenclature of the American Association of Anatomists and he was a member of the editorial board of the Archives of Neurology and Psychiatry. His medical fraternity, Phi Beta Pi, established an annual lectureship in his honor at the Northwestern University Medical School in 1929. He was elected to Alpha Omega Alpha while an undergraduate medical student.

Dr. Ranson was a dignified, modest and retiring man who felt keenly his responsibility for leadership for the advancement of knowledge in the neurological sciences. He did not hesitate to question dogma and didactic authorities and to stand his ground against attack and criticism. His interest was in establishing factual evidence rather than in selling himself. He worked diligently all his life, even to the detriment of his own health in later years. He was a devoted husband and father who found time to enjoy and contribute to the family circles.

The students who passed through his laboratory were extremely loyal to him and appreciated the fatherly interest he took in them. After they had left his laboratory, they continued to seek his help and advice and he always welcomed them. His accomplishments will live through time and his influence will be continued by his students and associates who have been keenly appreciative of his outstanding leadership and his high ideals.

JOSEPH C. HINSEY
CORNELL UNIVERSITY MEDICAL COLLEGE

HERBERT CLIFTON HAMILTON
1868–1942

HERBERT CLIFTON HAMILTON was born at Sandy Lake, Pennsylvania, on November 21, 1868. In 1897 he received his master's degree from the University of Minnesota in chemical engineering and immediately secured a position as chemist in the laboratory of a steel plant. After two years he joined the Parke, Davis and Company research staff as a pharmaceutical chemist and later took up pharmacological standardization work. His specialty was the study of germicides. Even after retiring on December 31, 1934, he continued germicidal studies at Pennsylvania State College and at the New York Experiment Station, Geneva.

He pioneered in the adaptation of biological assay methods to commercial use and contributed more than forty publications to that field of work. His studies involved disinfectants, insecticides, digitalis, ergot, hemostatic agents and posterior pituitary extracts.

Mr. Hamilton was a member of the American Chemical Society, the American Pharmaceutical Association and the American Public Health Association and attended many of their national conventions. He was associated with the Tenth Revision of the U. S. Pharmacopoeia as an auxiliary member of the committee.

His death occurred suddenly on November 13, 1942, as the result of an automobile accident.

OLIVER KAMM

RECENT DEATHS

DR. HOWARD HAWKES MITCHELL, since 1921 professor of mathematics at the University of Pennsylvania, died on March 13 at the age of fifty-eight years.

THE death at the age of sixty-seven years is announced of Dr. Frederick T. Van Beuren, Jr., president of the Morristown, N. J., Memorial Hospital since 1933. From 1921 to 1934 he served as associate dean of the College of Physicians and Surgeons of Columbia University.

ROLLO APPLEYARD, cable engineer, physicist and inventor, died on March 1 at the age of seventy-six years.

DR. R. R. MARETT, the anthropologist, rector of Exeter College, Oxford, died on February 18 in his seventy-seventh year.

A CABLE received by Yale University announces the death on March 6 at the age of seventy-two years of Dr. Arnold C. Klebs, Switzerland, specialist in medical and scientific bibliography.

SCIENTIFIC EVENTS

THE ROYAL OBSERVATORY AT THE CAPE OF GOOD HOPE

THE 1941 report of H.M. Astronomer at the Cape of Good Hope shows, according to *Nature,* only too clearly the impact of the war on South African astronomy. The reversible transit circle has been fairly fully employed in making 7,234 transit observations, including fifty-seven of the moon, which were undertaken in view of the fact that lunar observations have perforce been dropped from the restricted programs of many European observatories. With the Victoria telescope the stellar parallax program has been continued, 2,642 plates having been secured during the year. A new determination of the parallax of Proxima Centauri, the star closest to the sun, gives $0.763'' \pm 0.007''$, in good agreement with the previously accepted figure of $0.762'' \pm 0.005''$; this should be compared with the value $0.756'' \pm 0.007''$ for α Centauri. During recent years the number of plates used for a parallax determination has increased to thirty, taken over three years or more. This change is fully in accord with the experience gained in the cloudier weather (but better seeing) at Greenwich.

The photoheliograph record of the sun's disc has suffered somewhat from the shortage of fine-grain plates, but a record, either on lantern plates or faster emulsions, was obtained on 311 days. Observations of occultations by the moon indicate a correction of 0.77″ to its ephemeris longitude, which is of course based on Brown's Tables. This correction is expected to reach zero in 1943. Cometary observations included the photographing of Comet 1941*c* (de Kock), which reached the second magnitude, and of Comet Cunningham, which did not live up to expectations and only just reached naked-eye brightness. The weather at the Cape over the year was cloudier than usual, rainfall being 40 per cent. above normal, as the result of considerable falls on a large number of days rather than excessive falls on a few days. Substantial observing losses through cloud were recorded in the programs of the Victoria telescope and of the photoheliograph, but in spite of the weather the increased efforts of a war-depleted staff actually raised the number of observations made with the transit circle.

NEW HABITAT GROUPS OF THE AMERICAN MUSEUM OF NATURAL HISTORY

FOUR new habitat groups at the American Museum of Natural History have been opened to the public in the Whitney Memorial Hall of Birds. These groups show the bird life, flora and terrain of the Solomon Islands, Fiji, New Caledonia and the Great Barrier Reef of Australia. The exhibits were dedicated on the previous day at informal ceremonies attended by a number of invited guests and representatives of the Whitney family.

Since the opening of the Whitney Memorial Hall in June, 1939, with the completion of the first nine groups representing land and sea birds, principally of eastern and Mid-Pacific islands, the museum has sponsored further expeditions to other parts of the Pacific in order to round out its collections of accessories for the remaining nine exhibits.

A large part of this material was collected in 1940 by the late Lieutenant Adam Bruce Fahnestock and his brother, Captain John Sheridan Fahnestock, on the Fahnestock-American Museum of Natural History Expedition to island areas of the far southern Pacific. All field studies, botanical specimens and other accessories from sites represented in the four new groups were collected and shipped to the United States before the *Director II* was wrecked and sunk off the Great Barrier Reef, Australia.

Construction of the new groups was made possible by the gifts of Major Cornelius Vanderbilt Whitney for the hall, which is a memorial to his father, Harry Payne Whitney, and his grandfather, William C. Whitney. The groups were planned and assembled by Dr. James L. Clark, head of the department of arts and preparation, under the scientific direction of Dr. Robert Cushman Murphy, chairman of the department of birds. The accessories and foregrounds of the exhibits were prepared by George E. Petersen, who also accompanied the Fahnestock expedition as technical field assistant. Raymond B. Potter, assisted by George Adams, mounted the birds for the groups.

These new groups, like the previously completed exhibits, carry out the general design of Whitney Memorial Hall, planned to give visitors the illusion that from the middle of the Pacific Ocean they are viewing scenes of birdlife in every direction for thousands of miles. From mountainsides, white sandy beaches, islands of black volcanic rock or guano cliffs, a common horizon of clouds and sky rises to the blue vault of the flying bird dome that forms the ceiling of the hall. Francis Leo Jaques, artist and well-known painter of birds, also painted the backgrounds for the latest exhibits.

The collection of material for the five remaining groups planned for completion of the hall has been postponed for the duration of the war.

THE NUTRITION FOUNDATION

GEORGE A. SLOAN, president of the Nutrition Foundation, has announced that the foundation has authorized grants for the coming year amounting to $148,550. The grants were made on the recommendation of the Scientific Advisory Committee. They include $110,700 for the renewal of twenty-eight projects supported during 1942 and $37,850 for fifteen new research projects. Mr. Sloan stated that $316,000 in research grants to forty universities have been made since the organization meeting a year ago.

Dr. Charles Glen King, scientific director, reported to the board that projects undertaken in 1942 had already brought results which may have an important bearing on the food problems of both civilians and the armed forces.

Institutions that have received new grants are the University of Wisconsin, Harvard University, the University of Toronto, Columbia University, the University of California, the Johns Hopkins University, New York University, Massachusetts State College, the University of Chicago, Yale University, Cornell University, Oregon State College and the Oklahoma Experiment Station.

Dr. O. C. Carmichael, chancellor of Vanderbilt University, and Dr. F. G. Boudreau, of the Milbank Memorial Fund and chairman of the Food and Nutrition Board of the National Research Council, were elected public members of the foundation. Dr. V. P. Sydenstricker, of the University of Georgia Medical School, was appointed a member of the Scientific Advisory Committee.

The Rev. Hugh O'Donnell, president of Notre Dame University, and Cason J. Calloway, of Hamilton, Ga., who are public members of the board, were elected vice-chairmen. Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, is chairman of the board.

The Container Corporation of America, Chicago, Ill., and the Pillsbury Flour Mills Company, Minneapolis, Minn., were elected founder members. The National Sugar Refining Company, New York, N. Y., P. Duff and Sons, Inc., Pittsburgh, Pa., R. B. Davis Company, Hoboken, N. J., and the Curtiss Candy Company were elected sustaining members.

New members of the board of trustees, representing the new members of the foundation, were announced as follows:

Ellsworth Bunker, president, National Sugar Refining Company, New York; Walter P. Paepcke, president, Container Corporation of America, Chicago, Ill.; William H. Duff, II, president, P. Duff and Sons, Inc., Pittsburgh, Pa.; B. E. Snyder, treasurer, R. B. Davis Company, Hoboken, N. J.; Philip Pillsbury, Pillsbury Flour Mills Company, Minneapolis, Minn.; Otto Schnering, president, Curtiss Candy Company, Chicago, Ill.

NOTICE TO ZOOLOGISTS

THE following statement has been sent to SCIENCE by the War Emergency Committee of the American Society of Zoologists, of which Dr. Carl G. Hartman, of the University of Illinois, is chairman.

As there is every prospect of a most acute shortage of teachers of physics, mathematics and chemistry, it is suggested that zoology teachers possessing a background of training in these branches send their names and a restatement of their pertinent, specific qualifications to the Roster of Scientific and Specialized Personnel, 10th and U Streets, Washington, D. C. It is further suggested that zoology teachers in the smaller colleges who can teach the elementary phases of one or more of these subjects and who can be spared by their own institution get in touch with the nearest institution selected by the Army and Navy for large-scale teaching in these subjects.

There is urgent need also for medical parasitologists and medical entomologists. Ph.D.'s in parasitology or in entomology who have had four years' combined graduate work and practical laboratory or field experience are also needed. (Entomologists with a master's degree and two and one-half years of field experience may also apply.) Men who can qualify in these fields will find there an opportunity for direct service in the war effort. In most cases substitutes probably can be found to free such specialists for the service. Men may be accepted whose physical qualifications require limited service. For further information concerning medical parasitologists, entomologists and biochemists write to Captain Geo. R. Packard, A.U.S., Philadelphia, Headquarters Officer Procurement, 2442 Fidelity-Philadelphia Trust Building.

THE NAVY COLLEGE TRAINING PROGRAM

MEN between the ages of seventeen and twenty who wish to take advantage of the new Navy V-12 college training program must take a qualifying test which will be given in schools and colleges throughout the nation on April 2.

Men selected as potential officer material under this program will be sent to college by the Navy for varying lengths of time and will receive $50 per month pay as apprentice seamen in uniform. Eligible men who do not take the qualifying test on April 2 will not have another opportunity to do so for six months.

Students selected on the basis of officer-like qualities, including test scores, will be assigned to the Navy college training program in two groups, the first group reporting about July 1 and the second group about November 1.

High-school seniors and recent alumni should get

in touch with the principal or superintendent of their schools regarding details of the examination. The tests also will be administered by colleges and universities to their own students and to other high-school graduates in the vicinity.

The following will be eligible to take the test on April 2:

High-school or preparatory school graduates who will have attained their seventeenth but not their twentieth birthdays on July 1, regardless of whether they are attending college;

High-school or preparatory school seniors who will graduate by July 1 and who will be seventeen but not twenty years old at that time;

Students who are not high-school graduates, but who are continuing their education at an accredited college or university (the same age limits as above).

THE COPERNICAN QUADRICENTENNIAL

PROFESSOR HARLOW SHAPLEY, director of the Harvard Observatory, has accepted the chairmanship of the Copernican Quadricentennial National Committee, now being formed under the sponsorship of the Kosciuszko Foundation, of which Dr. Stephen P. Mizwa is director, to facilitate plans for the nationwide commemoration of the four hundredth anniversary on May 24 of the death of the great Polish astronomer, Nicholas Copernicus, and of the publication of his masterwork, "De Revolutionibus Orbium Coelestium."

A meeting will be held on the evening of May 24 in Carnegie Hall, New York City, at which Professor Shapley will preside. A number of distinguished speakers, including His Excellency, Jan Ciechanowski, Ambassador of the Republic of Poland to the United States, will take part.

One of the most interesting features of the quadricentennial will be participation by the nation's leading planetariums. The Hayden Planetarium, at the American Museum of Natural History in New York, of which William H. Barton, Jr., is curator, will present a special planetarium program during the month of May, depicting the Ptolemaic and Copernican conceptions of the solar system.

Arthur L. Draper, director of the Buhl Planetarium and Institute of Popular Science at Pittsburgh, plans to exhibit in the Hall of Astronomy whatever exhibits are available and pertinent.

The Fels Planetarium of the Franklin Institute in Philadelphia, of which F. W. Schlesinger is director and Dr. Roy K. Marshall is assistant director, are planning a planetarium demonstration of the solar system, paying tribute to the life and works of Copernicus. This lecture demonstration will be entitled "Systems of the World," based upon Galileo's famous "Dialogue on the Two Chief Systems of the World," written in 1632. Rare library copies, owned by the Franklin Institute, of the first and second editions of Copernicus's "De Revolutionibus" and a first edition of Galileo's "Dialogue" will be on display. The Polish flag will fly above this case of books and other forms of tribute will be paid to the Polish Allies. On the evening of May 24, it is planned to have a special "Polish Night" at the Planetarium.

Dr. C. H. Cleminshaw, acting director of Griffith Observatory in Los Angeles, and Mrs. Grace P. Johnson, director of the Museum of Natural History of Springfield, Mass., also will arrange planetarium programs.

SCIENTIFIC NOTES AND NEWS

DR. ARTHUR B. LAMB, professor of chemistry and dean of the Graduate School of Arts and Sciences of Harvard University, was presented on March 5 with the William H. Nichols Medal of the New York Section of the American Chemical Society for 1943 at a joint meeting of the section and the Society of Chemical Industry. The medal was awarded in recognition of "his investigations in inorganic and physical chemistry, his leadership in defense against poison gas, and as a teacher, administrator and editor." Professor Lamb's address was entitled "The Role of the *Journal* of the American Chemical Society in the Furtherance of Chemical Research in America." He has been the editor of the *Journal* for twenty-six years. Among the speakers who paid tribute to Dr. Lamb and his work were Dean Frank C. Whitmore, of Pennsylvania State College; Professor James W. McBain, of Stanford University, and Dr. Charles N. Frey, chairman of the New York Section, who presided.

THE three hundred and eighteenth meeting of the Washington Academy of Sciences, which was held on March 18, was devoted to the presentation by the academy of its awards for scientific achievement for 1942. They are as follows: In the biological sciences, to Robert S. Campbell, U. S. Forest Service, "in recognition of his distinguished service in range research, particularly in the development of range utilization standards"; in the engineering sciences to Walter Ramberg, National Bureau of Standards, "in recognition of his distinguished service in research on the static and dynamic strength of structural elements, particularly in relation to aircraft," and in the physi-

cal sciences to Milton Harris, National Bureau of Standards, "in recognition of his distinguished service in conducting fundamental research on the composition and properties of textile fibers."

THE Faraday Medal of the British Institution of Electrical Engineers has been awarded to Sir Archibald Page, past president of the institution.

THE Council of the Physical Society, London, has awarded the Charles Chree Medal and Prize for 1943 to Professor (now Colonel) B. F. J. Schonland and the Duddell Medal for 1942 to Dr. C. R. Burch. Colonel Schonland, formerly professor of physics at Cape Town and afterwards director of the Bernard Price Institute of Geophysics at Johannesburg, is now in Great Britain engaged in scientific work in connection with the war. Dr. Burch, formerly of the Research Department of the Metropolitan-Vickers Electrical Company, has continued his work in the physics laboratories of the Imperial College and the University of Bristol.

THE doctorate of science will be conferred on April 18 at the commencement exercises of the University of Dayton on Jeanne S. Schwengel, research associate of the Academy of Natural Sciences, Philadelphia, in recognition of "notable contributions to science in the field of conchology."

F. C. LEA, formerly professor of engineering at the University of Sheffield, has been elected president of the British Institution of Mechanical Engineers.

THE following members of the faculty of Yale University will retire at the close of the academic year: Dr. Treat B. Johnson, Sterling professor of chemistry; Dr. Herman H. Chapman, Harriman professor of forest management; Dr. Richard S. Kirby, associate professor of engineering drawing, and James K. Whittemore, associate professor of mathematics.

DR. DAVID J. DAVIS, professor and head of the department of pathology, bacteriology and public health and dean of the College of Medicine of the University of Illinois, will retire on September 1.

SIR FARQUHAR BUZZARD, regius professor of medicine at the University of Oxford, will retire in April. *The British Medical Journal* reports that his friends and colleagues wish to commemorate his work, and that a representative committee has suggested that his portrait should be painted and that a Buzzard scholarship or prize in medicine should be endowed.

DR. WALTER E. SULLIVAN, professor of anatomy and head of the department of the University of Wisconsin, is serving for six months as visiting professor of anatomy at the School of Medicine of Washington University, St. Louis.

DR. BERNARD H. KNIGHT, research officer in highway engineering at the University of the Witwatersrand, Johannesburg, has been appointed to the newly established chair of highway engineering in that university, the appointment to take effect on April 1. *Nature* states that it is believed that this chair of highway engineering, which is tenable in the department of civil engineering, is the first of its kind to be founded in the British Empire outside Great Britain.

DR. ALASTAIR FRAZER, reader in pharmacology in the University of Birmingham, has been appointed professor of pharmacology, a new chair recently established at the university.

DR. HENRY C. SHERMAN, professor of chemistry at Columbia University, has been appointed head of the newly established Bureau of Human Nutrition and Home Economics of the U. S. Department of Agriculture.

DR. ALBERT L. ELDER, of the department of chemistry of the College of Liberal Arts of Syracuse University, who has indefinite leave for service with the War Production Board, has been made its chief chemical adviser. His previous position was that of principal industrial analyst.

DR. FRANKLIN CHURCH BING, formerly secretary of the Council on Foods and Nutrition of the American Medical Association, has been appointed a director of the American Institute of Baking.

DR. JOHN W. CROSSON, since 1940 director of the bureau of industrial hygiene of the West Virginia State Department of Health, has become industrial consultant for Sharp and Dohme. He will join the medical research staff in Philadelphia.

J. A. STEERS, dean of St. Catharine's College, Cambridge, and university lecturer in geography, has been appointed adviser to the British Minister of Town and Country Planning on scientific matters connected with the preservation of the coast line.

DR. EARL B. WORKING, for the past twenty years a member of the staff of the department of milling industry of the Kansas Agricultural Experiment Station at Manhattan, plans to leave late this month for Port au Prince, Haiti. The Société Haitiano-Americaine de Developpement Agricole has received a grant-in-aid from the Board of Economic Warfare and, in cooperation with the Rubber Reserve Corporation, has undertaken the production of rubber from the Cryptostegia plant, a member of the milkweed plant family. Dr. Working will be director of chemical research for the rubber project and will have supervision of the research laboratory at Gonaives, Haiti.

DR. JERZY NEYMAN, director of the Statistical

Laboratory of the University of California, addressed on March 3 a joint meeting of the Yale Chapter of Sigma Xi and the Connecticut Chapter of the American Statistical Association in New Haven. His subject was "The Probabilities of Errors of the Second Kind and the Design of Experiments."

DR. CARL S. MARVEL, professor of organic chemistry at the University of Illinois, will deliver on April 2 at the University of Chicago the third annual lecture under the Julius Stieglitz Memorial Lectureship. He will take as his subject "The Structure of Vinyl Polymers."

DR. FRANCIS G. BLAKE, Sterling professor of medicine and dean of the Yale University School of Medicine, gave on January 28 the first annual Begg Society Lecture at the School of Medicine of Boston University on "Epidemic Diseases in Wartime."

DR. SAMUEL W. CLAUSEN, professor of pediatrics at the University of Rochester School of Medicine, delivered on March 18 at the New York Academy of Medicine the sixth Harvey Society Lecture of the current series. His subject was "The Absorption of Vitamin A and its Storage in the Tissues."

DR. VINCENT DU VIGNEAUD, professor of biochemistry and head of the department, Cornell University Medical College, New York, gave an address on March 18 before the Chicago Section of the American Chemical Society. He spoke on "The Chemical Nature of Biotin."

THE annual conference of the Institute of Food Technologists for 1943 will be held in St. Louis on June 2, 3 and 4. The Hotel Statler has been selected as headquarters. All meetings, under the presidency of Dr. R. C. Newton, will be related to the problem of food processing during the war effort. On the evening of June 2 the Nicholas Appert Medal Award will be made. All registered members will attend the opening of the St. Louis Municipal Opera on the evening of June 3 as guests of the St. Louis Section, of which Dr. E. H. Harvey is general chairman.

A CONFERENCE, sponsored by the New York Academy of Sciences, on Parasitic Diseases and American Participation in the War, presided over by Dr. Horace W. Stunkard, of New York University, was held on March 13. The speakers were Dr. Lowell T. Coggeshall, of the School of Public Health of the University of Michigan; Dr. Norman R. Stoll, of the Rockefeller Institute for Medical Research, Princeton, N. J.; Dr. Robert Matheson, of Cornell University, and Dr. Thomas T. Mackie (Lt. Colonel), of the Army Medical School, Washington, D. C.

THE three hundred and ninety-fourth meeting of the American Mathematical Society was held at Columbia University on February 27. The attendance was approximately two hundred, including one hundred sixty-six members of the society. Two addresses were given by invitation of the Program Committees: "Transformation Groups and Spheres," by Professor Deane Montgomery, of Smith College, and "Some Topics in the Theory of Semi-linear Transformations," by Professor Nathan Jacobson, of the University of North Carolina. Professor Montgomery's address had been scheduled originally for the annual meeting, which was cancelled on account of transportation difficulties. There were also four sessions at which twenty-two contributed papers were presented on analysis, algebra, applied mathematics, geometry and statistics. Thirteen additional papers were presented by title. The council of the society held a meeting at noon on Saturday, at which, among other things, a report of the War Policy Committee was approved.

THE annual meeting of the International Association for Dental Research was held in Chicago on March 13 and 14.

APPLICATIONS for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the committee, Professor Frederick G. Keyes, of the Massachusetts Institute of Technology, not later than April 15. Grants are made in aid of chemical research, generally for apparatus or supplies, or for the construction of special facilities needed for research in chemistry or in fields closely related to chemistry. Grants are not awarded for salaries, and on account of limited resources the amount of a grant to an individual is seldom in excess of $300. Application blanks may be obtained from the chairman upon request.

Two fellowships are offered by the Cinchona Products Institute of New York for clinical or pharmacological research on quinine or the other alkaloids of cinchona. They carry a yearly stipend of $2,000, plus necessary laboratory or routine expenses. Further details may be secured from Cinchona Products Institute, Inc., 10 Rockefeller Plaza, New York.

A RESEARCH assistantship in petroleum physics has been established by the Gulf Oil Corporation at the Massachusetts Institute of Technology. The recipient must qualify for a tuition scholarship and be a candidate for an advanced degree in the department of physics. The stipend is $1,100 per school year, subject to renewal at the end of nine months under an accelerated program. Applications should be made before April 1 on forms obtained from the admissions office.

DISCUSSION

OCCURRENCE OF THE PLIOCENE ANTELOPE, ILINGOCEROS, IN NEVADA

UNTIL recently the only known occurrence of the peculiar twisted-horn antelope, *Ilingoceros,* was that recorded by Dr. J. C. Merriam[1] from the Thousand Creek Pliocene deposits of northwestern Nevada. During the past 30 or more years much interest has been manifested by students of fossil mammals in the paleontological history of the Antilocapridae. The family has come to be recognized as having a unique position in American animal life. Thus, its representation to-day by a single genus, *Antilocapra,* stands in decided contrast to the great diversity of type which characterized the family in former geologic time. The existence of many different kinds of antelopes in the past is exemplified by the several extinct genera in Pleistocene faunas, but even more so by the unusual and even bizarre creatures of the Pliocene.

Although the extended studies which have been conducted on the later Tertiary faunas of western North America and their correlation have brought to light new genera of antelopes, it is rather odd that no new occurrences of *Ilingoceros* have been found.

Pliocene localities at Smith Creek in central Nevada, yielding fossil mammalian remains, were discovered by Stock and Furlong about 1928. Later, in 1931 and 1934, summer field parties from the California Institute of Technology conducted further explorations in this region and obtained additional materials. No complete survey has been made as yet of the fossil assemblage. R. W. Wilson[2] published a report on the rodents in the fauna, and on the basis of this study correlated the Smith Creek fauna with that from the middle Pliocene Thousand Creek beds.

A recent survey of the larger fossil mammals from the Smith Creek Pliocene in the paleontological collections of the California Institute of Technology brought to light a fragment of a frontal bone with the basal part of the horncore and roof of the orbit. On the basis of size, proportions and morphological characters shown by this specimen, No. 795, C. I. T. Coll., there can be no doubt that it belongs to *Ilingoceros.* Associated limb elements confirm this conclusion. Hence the geographic range of the genus is extended, at least locally in what is now the Great Basin region, and the identification lends further support to Wilson's view that the Smith Creek and Thousand Creek faunas are closely related in time.

E. L. FURLONG

CALIFORNIA INSTITUTE OF TECHNOLOGY

[1] J. C. Merriam, *Univ. Calif. Publ., Bull. Dept. Geol.,* Vol. 5, No. 22, pp. 319–330, 7 figs., 1910.

[2] R. W. Wilson, *Carnegie Inst. Wash. Publ.* No. 473, pp. 15–34, 2 pls., 1936; *Carnegie Inst. Wash. Publ.* No. 487, pp. 21–73, 1937.

HALOGETON GLOMERATUS, POISONOUS TO SHEEP

Halogeton glomeratus (Chenopodiaceae) has been reported to have established itself in northeastern Nevada in 1935 and has spread rapidly over the range.

In an area a few miles south of Wells, Nevada, there have been heavy sheep losses during the past two years which have been suspected to have been due to this plant.

Examination of a sample of the plants from the area on which poisoning has recently occurred has disclosed the presence of large quantities of oxalates, which has justified the suspicion that this plant was the active agent.

Chemical analysis showed the dried sample to contain total oxalates equivalent to 19 per cent. anhydrous oxalic acid. Oxalates in water-soluble form were found equivalent to 11 per cent. anhydrous oxalic acid.

The presence of calcium oxalate crystals may be easily demonstrated by shaking the dry ground plant with water when the calcium oxalate may be seen at the bottom of the liquid, the greater part of the plant tissue floating to the surface.

The presence of several other crystalline compounds was observed with the compound crystals of calcium oxalate. These will be investigated further.

The occurrence of oxalates in members of the Chenopodiaceae is well known but in the quantities found in this plant, somewhat unusual. No mention has been found in the literature of the occurrence of oxalates in *Halogeton glomeratus* nor of possible poisonous properties to animals eating the plant.

M. R. MILLER

CHEMICAL LABORATORY,
NEVADA AGRICULTURAL EXPERIMENT STATION,
UNIVERSITY OF NEVADA

WAR WORK IN THE HIGH SCHOOLS

THE high schools of the country are now asked to train the boys and girls in a way never before attempted. Workers of all kinds are now in demand. Much of this work requires thought and skill. They must acquire the ability to think straight and to work steadily and accurately in the shortest possible time. Industry, agriculture, business and the armed forces are all in need of them.

Young people are asked to prepare immediately for one of five major needs. (1) The armed forces need men with practical technical training. An increase in the armed forces of approximately three million men is expected by the end of 1943 or early in 1944. The men needed most are those with specific

types of preparation. (2) A continuous supply of scientifically trained workers is demanded. These include especially physicists, meteorologists, radio engineers, all other types of engineers and medical men. (3) The war industries have definite and immediate need for men with practical technical training. (4) Industry and civil life need a continuous supply of physicists, engineers, doctors, chemists and biologists, both for war production and for essential civilian needs. (5) Agriculture and business must have the continuous services of boys and girls. The more training these young people have the more efficient they become for taking the places usually held by older and more experienced people.

Five pre-induction courses have been presented by the War Department and the U. S. Office of Education in elementary electricity, elementary machines, elementary shopwork, automotive machines and radio. Emphasis on these courses will prepare many students for much-needed work, but some students should prepare to go further while others not suited for work of this type must select other useful fields. It is the business of the high school to classify the students and prepare each for the type of this essential work for which he is best adapted.

The Cooperative Committee on Science Teaching has made a definite study of each of the four great science groups—physics, mathematics, biology and chemistry—and offers suggestions on the best courses for the high schools to pursue to meet the changes demanded by the war. These recommendations are published in the February issue of *School Science and Mathematics*. Copies of the report may be obtained by applying to Robert J. Havighurst, The University of Chicago.

GLEN W. WARNER

WOODROW WILSON CITY COLLEGE,
CHICAGO

SCIENTIFIC BOOKS

COMPARATIVE VERTEBRATE ANATOMY

Comparative Vertebrate Anatomy. By LIBBIE HENRIETTA HYMAN. 2nd edition. University of Chicago Press. i–xx, 1–544 pp. 136 figs. 1942. $3.50.

IT is hardly possible to review a book properly without also undertaking some sort of analysis of the purpose for which it was written. This is all the more desirable in the present field, because books for use in comparative anatomy classes have not in the past proved entirely satisfactory.

Comparative anatomy of vertebrates is a broad field that it is really impossible to segregate from embryology. It covers the range of vertebrate variation and necessitates more or less dissection—a time-consuming occupation. In breadth it might well be compared with History. Suppose, in his progress from kindergarten to Ph.D., one had not more than 90 hours to cover the extent of History—Ancient, Roman, English, French and United States combined. And yet the student is usually given in comparative anatomy a breadth of field and a wealth of detail that it would take him years to cover adequately.

The only students needing much detailed knowledge of comparative anatomy are those expecting to make a career of either zoology or medicine. To the very much larger percentage of other students the subject is merely an academic discipline the minutiae of which they will soon forget. For such of these as elect it, the presentation should either be combined with embryology, or in a condensed course of one semester, stressing principles and bearing somewhat the same relation to the topic as the course in physiology and anatomy for trained nurses does to these subjects as offered to the student of medicine. From the standpoint of the medical student, at least, what is desired is a working understanding of the phylogeny of the systems—how the parts of the body get that way—rather than a precise knowledge of the anatomy of dogfish, mud puppy or tortoise.

Miss Hyman is a gifted writer of text-books, as she demonstrated in her "Laboratory Manual for Comparative Vertebrate Anatomy" (1922), a book that has been very widely used. The volume under review is a second edition of this, some 30 per cent. larger, with parts rewritten and amplified, and almost twice as many figures. It is now less frankly a dissecting manual. Few, I think, can find fault with the author's plan of procedure as set forth in her prefaces. She is fully aware of the difficulty in presenting such a broad subject in a limited space, particularly by one whose chief research interests lie in the field of invertebrates. Her approach, from the systemic rather than from the type aspect, is in accordance with progressive ideas generally entertained on the subject.

The dogfish, mud puppy, turtle, rabbit and cat are the forms receiving particular consideration, but some attention is paid to other kinds as well. Birds are omitted, as they are so specialized that they hardly belong in a work of this scope. It is probable that the turtle could also be dropped, with some benefit to the student. Both rabbit and cat, especially the latter, are firmly entrenched in zoological curricula, on the basis of availability. In some respects they are entirely satisfactory, but in others, as skeletal and muscular systems, they are quite specialized. Some col-

leges have already found it decidedly worth while, in spite of increase in cost, to use the macaque monkey exclusively for mammalian dissection. This is so very desirable, from the standpoint of the premedical student, that it would have been a progressive step to substitute this mammal for rabbit and cat.

Workers in the phylogeny of vertebrates, including anatomists and embryologists, have been increasingly aware during recent years that one of the greatest needs in this general field is a scrutiny and revaluation of all the old concepts laid down dogmatically several scores of years ago and copied in one generation of text-books after another. The old masters were most gifted zoologists, but the style then was to build, at all costs, complete evolutional and developmental pictures, filling voids with what they believed to be plausible interpretations. Recent books have far too many old illusions interlarded among proven facts. Although Miss Hyman specifically recognizes this situation, she, nevertheless, has succumbed to the temptation of presenting complete, rule-of-thumb developmental pictures. The temptation is great and I have done the same myself, frequently.

One using this book will, I think, wish for more illustrations of a factual nature. There is a sufficient number of embryological figures, and of some other categories, but still other subjects are scantily pictured. Although the turtle is the reptile stressed, none of its musculature is shown, but instead, that of the tuatara, alligator and reconstructions of extinct reptiles. The student needs facts shown, and of forms that he is able to observe. There is no illustration of the peripheral nerves, although the limb plexuses, for instance, may be much more clearly pictured than described; there are no figures of the eye, *et cetera*. The anatomy of hand and foot is of much importance, and yet consideration of the soft parts of the limbs ends at wrist and ankle.

Much of the criticism that might with justice be aimed at this book would apply to any short treatise on the subject. The fact remains, however, that the author has given us the most useful text-book on comparative vertebrate anatomy so far available in the English language.

A. BRAZIER HOWELL

COLLEGE CHEMISTRY

Essentials of College Chemistry. By NORMAN KHARASCH and HELEN S. MACKENZIE. xii + 513 pp. New York: D. Van Nostrand Company, Inc. 1942. $3.50.

UNDER this title the authors, both staff members of the Illinois Institute of Technology, have produced a very readable, well-indexed introduction to general chemistry. Their style is clear, direct and unhurried. The illustrations, consisting of 99 figures and 48 tables, are pertinent and well-balanced. The value of the text is enhanced by the use of large, clear type, non-glossy paper and durable binding.

Faced with the necessity of choosing from the vast accumulation of introductory material, the authors have placed extra emphasis upon the structure of matter, and by their omissions and order of arrangement constantly remind us that success lies around many corners.

Each of the twenty-three chapters includes selected references; twenty of them are followed by exercises and six by summaries. Some of the others could have been similarly treated to advantage. The reference book list records but seven general chemistry texts.

Separate title pages divide the text as follows: Introduction; The States of Matter; The Theory of Ionization; The Non-Metals; The Metals; Introduction to Organic Chemistry; The Ceramic Industries; Appendix; Index. These sections do not necessarily indicate their scope. For example, the section titled "The States of Matter" comprises eight chapters, among them, "Atoms-Molecules-Chemical Changes," "The Velocity of Chemical Reactions" and "The Periodic Classification of the Elements." The appendix includes an "Outline of the History of Chemistry," "Rules of Nomenclature for Inorganic Compounds," "Solubilities of some Salts at 20° C" and "Vapor Pressure of Water." A "Table of International Atomic Weights" appears on the inside back cover. The excellent chapter on "Ceramics" was written by an invited specialist in the field.

Some teachers will object to the compression within a single chapter of oxygen, ozone, hydrogen, hydroxides, oxidation, reduction, endo- and exothermic reactions, the activity series of the metals, valence and chemical equivalents. These 22 pages are busy ones indeed. Other teachers will be delighted to find 20 per cent. of the text devoted to carbon and organic chemistry—trimmed freely with structural formulas for sugar and vitamins and such substances as mercurochrome, alizarine, salvarsan and phenolphthalein.

Strong features of the text are acids, bases, hydrolysis, chemical equilibrium, isomerism and structural formulas. The authors employ delightful analogies and techniques to make their points clear. The same strength does not carry over into the field of applied chemistry. And it is unfortunate that the text should be marred by inaccuracies and inconsistencies.

Explosives and combustible mixtures are confused. "$\triangle$" over an equation is used promiscuously to indicate either endothermic action or elevated temperature. Electrolytic equations are written first $2\,Cl^- - 2\,e \rightarrow 2\,Cl$ and then $2\,Br^- \rightarrow 2\,Br + e$.

According to the authors, "the free metal (barium) is not prepared commercially and has no uses"; the fluorine molecule is "stable at all temperatures"; "the oxide (of aluminum) is infusible"; "the decomposition of potassium chlorate into potassium chloride and oxygen . . . (is) . . . endothermic"; "barium melts at 850° C and boils at 1140°."

R. A. Baker

Brief College Chemistry. By Leon B. Richardson and Anderw J. Scarlett. vi + 385 pp. 128 figs. New York: Henry Holt and Company. 1942. $3.00.

Written in the refreshing style already associated with these authors, this brief text is no scissors-and-paste abstract, but a paraphrase of their earlier works. Because it is scholarly it happily stands apart from those "science survey" texts which dilute science to the level of the tabloid.

There are five introductory chapters on valence, atomic structure and the periodic table; eight chapters on physical chemistry, including energy, states of matter, equilibrium—introduced probably too early for an elementary course—chemical calculations, the ionic properties of solutions, and a logical use of the Brønsted treatment of acids and bases; eight chapters on the non-metals and seven on the metals, with two concluding chapters on organic chemistry. Sandwiched into physical chemistry is the chemistry of water and its constituent elements; electrochemistry is interposed between aluminum and iron; colloids are inserted between phosphorus and carbon. Although these special topics are arbitrarily located, at least they are consistently handled.

This brief, elementary, but authoritative text should supplant its several inferior predecessors.

Hubert N. Alyea

Introductory College Chemistry. Second edition. By Horace G. Deming. 521 pp. 176 figs. New York: John Wiley and Sons, Inc. 1942. $3.00.

Now written in collaboration with Professor Hendricks, this well-known, attractive and particularly reliable elementary text has been entirely reset in larger, clearer type. Chapter headings remain the same as in the first, 1933, edition. Cuts of modern industrial products and processes, new sections on the structure of liquids and solids, x-ray studies, photography, plastics, vitamins and animal nutrition considerably improve and modernize the subject-matter.

Hubert N. Alyea

Princeton University

SPECIAL ARTICLES

INCREASED SYNTHESIS OF p-AMINOBENZOIC ACID ASSOCIATED WITH THE DEVELOPMENT OF SULFONAMIDE RESISTANCE IN STAPHYLOCOCCUS AUREUS

The means by which bacteria become resistant to the bacteriostatic action of the sulfonamide drugs has remained obscure, although this phenomenon has been known for several years[1] and has been observed in a number of bacterial species.[2,3,4,5,6] While a sizable body of information on the technique of development of resistance *in vitro* has accumulated and its clinical analogue has been described, careful study has failed to disclose significant differences (in morphology, carbohydrate fermentation, growth rates, virulence, etc.) between sulfonamide-resistant and susceptible organisms. With the failure to solve the problem by the use of orthodox bacteriological procedures, the method of attack has shifted to the biochemical.

It has been postulated[7] and indirect evidence suggests[8,9,10] that increased p-aminobenzoic acid (PAB) synthesis by sulfonamide-resistant organisms may account for their lack of sensitivity to sulfonamides. This explanation has not been proved heretofore, since no adequate test for PAB was available. The development by Landy and Dicken[11] of a suitable microbiological method for the determination of PAB made possible a quantitative comparison of the amounts of PAB synthesized by sulfonamide-sensitive and resistant bacteria. Evidence presented in this report indicates that sulfonamide-resistant strains of *Staphylococcus aureus* produced significantly more PAB than the corresponding sensitive strains.

The cultures investigated were *S. aureus* strains 7 and 14 supplied by Dr. Wesley Spink, of the University of Minnesota Medical School, who has described their susceptibility to sulfonamide inhibition *in vitro*.[12]

1 I. H. MacLean, K. B. Rogers and A. Fleming, *Lancet*, I: 562, 1939.
2 C. M. MacLeod and G. Daddi, *Proc. Soc. Exp. Biol. and Med.*, 41: 69, 1939.
3 L. Westphal, R. L. Charles and C. M. Carpenter, *Ven. Dis. Inform.*, 21: 183, 1940.
4 E. Strauss, J. H. Dingle and M. Finland, *Jour. Immunol.*, 42: 313, 1941.
5 E. Strauss, J. H. Dingle and M. Finland, *Jour. Immunol.*, 42: 331, 1941.
6 H. N. Green, *Brit. Jour. Exp. Path.*, 21: 38, 1940.
7 D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.
8 C. M. MacLeod, *Jour. Exp. Med.*, 72: 217, 1940.
9 H. N. Green and F. Bielschowsky, *Brit. Jour. Exp. Path.*, 23: 1, 1942.
10 G. S. Mirick, *Jour. Clin. Invest.*, 21: 628, 1942.
11 M. Landy and D. M. Dicken, *Jour. Biol. Chem.*, 146: 109, 1942.
12 J. J. Vivino and W. W. Spink, *Proc. Soc. Exp. Biol. and Med.*, 50: 336, 1942.

Resistance had been induced by exposure of the parent strains to increasing concentrations of sulfathiazole. These cultures were maintained by us in a chemically defined, PAB-free medium[13] which supported growth equivalent to that obtained with meat infusion broth. This medium was used in all the following experiments. The results of the determination of the sensitivity and resistance to sulfonamides of the *S. aureus* strains are given in Table I. Although

TABLE I

BACTERIOSTATIC ACTION OF THE SULFONAMIDE DRUGS ON PARENT AND RESISTANT STRAINS OF STAPHYLOCOCCUS AUREUS GROWN IN SYNTHETIC MEDIUM

Sulfonamide drug	Staphylococcus aureus 7: Parent inoculum 620 org.	Staphylococcus aureus 7: Resistant inoculum 315 org.	Staphylococcus aureus 14: Parent inoculum 1860 org.	Staphylococcus aureus 14: Resistant inoculum 124 org.
Sulfanilamide	1 = N 100 = P 500 = C	2,000 = N 12,500 = P 15,000 = C	50 = N 500 = P 1000 = C	20,000 = N
Sulfaguanidine	1 = N 10 = P 500 = C	2,000 = N 20,000 = P	10 = N 500 = P 1000 = C	20,000 = N
Sulfadiazine	10 = N 50 = P 100 = C	10,000 = N 12,500 = C	10 = N 50 = P 100 = C	10,000 = N 12,500 = C
Sulfathiazole	0.1 = N 0.5 = P 1.0 = C	1,000 = N 4,000 = P 8,000 = C	0.5 = N 1.0 = P 10 = C	4,000 = N 6,000 = P 8,000 = C

The concentration of sulfonamides is expressed in γ per 10 cc culture.
N = None, no inhibition of growth, growth same as control.
P = Partial inhibition of growth compared with control at 72 hours.
C = Complete inhibition of growth. No growth or cloudiness in 72 hours.

originally exposed only to sulfathiazole, it is evident that a high degree of resistance to the other sulfonamides has been established as well in both strains of *S. aureus*. More marked resistance to sulfadiazine and sulfathiazole than to sulfanilamide and sulfaguanidine appears to have been developed. It is possible, however, that this is more apparent than real, since fairly high concentrations of sulfanilamide and sulfaguanidine are tolerated by the parent strains while they are more sensitive to sulfadiazine and particularly to sulfathiazole.

For the determination of PAB synthesis by the parent and resistant strains of *S. aureus*, the cultures were transferred a number of times in the synthetic medium, thus reducing the possibility of carrying over any PAB. Plate counts after 24 hours incubation revealed that the populations of the four cultures were approximately equal. Small inocula of the cultures, averaging several thousand organisms, were introduced into 50 cc volumes of synthetic medium, incubated for 24 hours at 37° C, filtered through Seitz filters and the filtrates autoclaved and assayed for PAB by the method of Landy and Dicken.[11] The results of the assay of the *S. aureus* culture filtrates[14] are given in Table II. It will be seen that the data

TABLE II

p-AMINOBENZOIC ACID CONTENT OF STAPHYLOCOCCUS AUREUS FILTRATES AT VARYING ASSAY LEVELS

Amount of filtrate per assay flask	p-Aminobenzoic acid: Found, No. 7	Found, No. 14	Content, No. 7	Content, No. 14
Parent Strains				
cc	γ	γ	γ per cc	γ per cc
1.00	.042	.047	.042	.047
0.50	.024	.024	.048	.048
0.25	.014	.013	.056	.051
0.10	.005	.005	.050	.050
Average			.049	.049
Resistant Strains				
cc	γ	γ	γ per cc	γ per cc
0.025	.080	.082	3.20	3.28
0.010	.033	.033	3.30	3.30
0.005	.016	.017	3.20	3.40
0.0025	.008	.009	3.20	3.60
Average			3.22	3.40

are in good agreement both as regards PAB content at various levels of assay and in the amounts found for strains 7 and 14. The quantity of PAB produced by resistant strains in contrast to that by parent strains is particularly impressive.

Since PAB was found in the culture filtrates in considerable amounts it was deemed advisable to measure its concentration by chemical as well as by microbiological means. Using the Litchfield-Marshall colorimetric test,[15] with crystalline PAB as the standard, values were obtained which were in fair agreement with those obtained by microbiological assay (Fig. 1). It should be pointed out that the diazo reaction could be employed here only because relatively large quantities of PAB were present,[16] since the method does not possess the sensitivity characteristic of the microbiological assay. It is well known that the chemical test is not specific for PAB, but is a measure of the concentration of primary aromatic amines.

S. aureus cultures were grown in the presence of

[13] The medium of M. Landy and D. M. Dicken, *Jour. Lab. and Clin. Med.*, 27: 1086, 1942, omitting sodium acetate, asparagine, guanine, xanthine and uracil. pH is readjusted to 7.5.

[14] Comparative assays performed on *S. aureus* filtrates and acid hydrolyzed whole cultures revealed that the bulk of PAB produced is secreted into the medium, since the filtrates contained almost as much as did the culture hydrolysates.

[15] J. T. Litchfield, Jr. and E. K. Marshall, Jr., SCIENCE, 88: 85, 1938.

[16] It is likely that the values obtained for PAB synthesis by the parent strains are in error since the quantity found for these strains by microbiological assay is known to be too small for detection by the chemical method.

sulfonamides[17] and the filtrates assayed for PAB. While the presence of sulfonamide in the culture filtrates made the subsequent quantitative measurement of PAB impossible (since sulfonamides inhibit the growth of *Acetobacter suboxydans*)[18] we were definitely able to ascertain that PAB synthesis was greater by resistant than by parent strains.

It is clear that sulfonamide-resistant staphylococci grown in a synthetic, PAB-free medium synthesize far more PAB than do the parent strains of the same

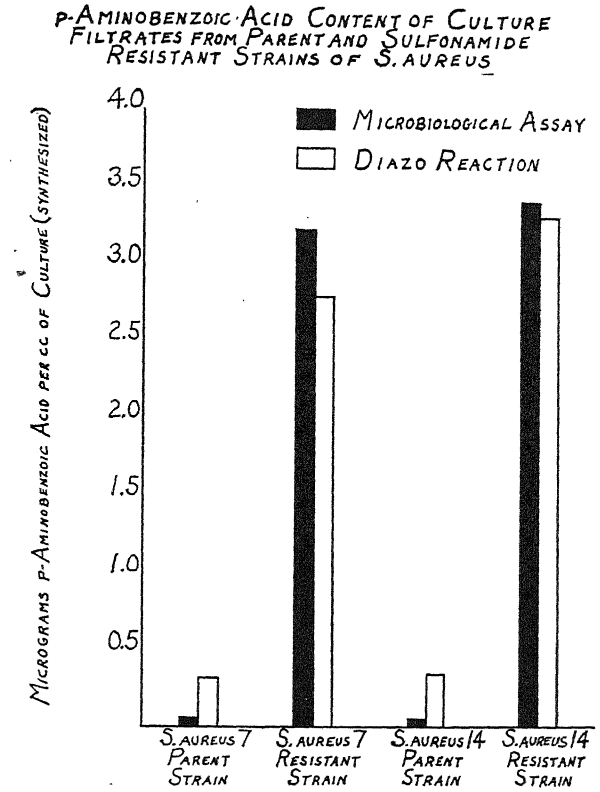

FIG. 1

organism. Under our test conditions this ratio is consistently in the order of 70 to 1. This great output stands in contrast to the amount of PAB synthesized by a variety of organisms representative of twelve bacterial genera.[19] None of these organisms studied produced PAB in quantities approaching that made by sulfonamide-resistant staphylococci. The average for all other organisms was 0.033 micrograms PAB per cc of culture, while the resistant staphylococci produced 3.3 micrograms of PAB per cc, or 100 times as much. Based on their inhibition by sulfonamides *in vitro* (Table I), the quantity of PAB synthesized by sulfonamide-resistant staphylococci is in considerable excess of that known to be required for reversal of the inhibitory action of the quantity of sulfonamide to which these organisms are resistant.[7]

Sulfonamide-resistant staphylococci continue to synthesize PAB far in excess of that normally produced by *S. aureus* for many generations following exposure to sulfonamides. It has been stated[6, 20] that although sulfonamide fastness may be lost when only partially developed, well-established resistance is apparently retained indefinitely. Continued increased production of PAB by these resistant staphylococci may be considered as additional evidence for the permanence of sulfonamide fastness.

As a result of these and other data obtained from our PAB studies, we are of the opinion that the staphylococcus cell, becoming resistant to sulfonamides, undergoes fundamental changes in its PAB metabolism. That organisms may acquire resistance to sulfonamides without increasing their production of PAB is indicated by our studies[21] on *Escherichia coli, Vibrio cholerae, Shigella dysenteriae* and *Diplococcus pneumoniae*. Sulfonamide-resistant strains of these organisms failed to synthesize greater amounts of PAB than did their parent, non-resistant, strains. The possibility exists, however, that future investigation will reveal that these resistant organisms produce other "antisulfonamide metabolites" as yet unidentified, which do not support growth of our test organism, *A. suboxydans*.

SUMMARY

Sulfonamide-resistant strains of *Staphylococcus aureus* produce greater amounts of p-aminobenzoic acid than do their parent strains. This synthesis occurs both in the absence and in the presence of sulfonamides. The quantity of p-aminobenzoic acid synthesized by resistant strains appears sufficient to account for their resistance to sulfonamide drugs.

On the basis of this evidence, it is suggested that the development of ability to synthesize p-aminobenzoic acid in excess of the normal metabolic requirements, as a result of continued exposure to sulfonamides, explains the phenomenon of sulfonamide fastness in *Staphylococcus aureus*.

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17 Sulfanilamide and sulfadiazine were employed. The amounts used varied from 1/10 to the maximum concentration which would still allow growth equal to that of controls (*cf.* Table I).

18 M. Landy, N. W. Larkum and E. J. Oswald, *Jour. Bact.*, in press.

19 M. Landy, N. W. Larkum and E. J. Oswald, *Jour. Bact.*, in press.

20 L. H. Schmidt, C. Sesler and H. A. Dettwiler, *Jour. Pharmacol. and Exp. Therap.*, 74: 175, 1942.

21 M. Landy, N. W. Larkum, E. J. Oswald and F. Streightoff, to be published.

ON THE CELLULAR DIVISION OF SPACE WITH MINIMUM AREA

THE problem of the division of space into congruent cells of minimum area has been studied previously. By means of the Calculus of Variations, one may demonstrate easily that such cells must have dihedral angles of 120°. The rhombic do-decahedron is a figure which possesses the characteristic of filling space and having all its dihedral angles of 120°, and on that account was considered for a long time as the

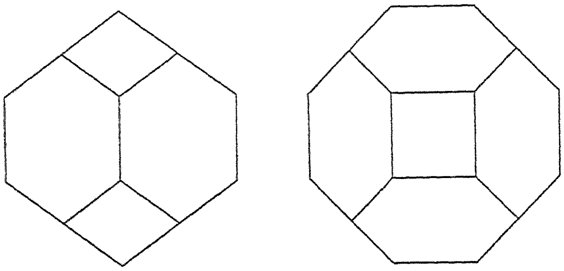

FIG. 1.

solution of the problem. One of the facts that raised a doubt as to whether it might be is that in nature, in all the cases of division of space in which the surface tends to diminish in area, there have been further hexagonal faces. The problem was resolved, however, in decisive form by Lord Kelvin.[1] Basing his argu-

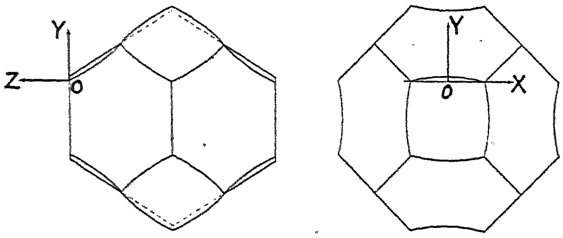

FIG. 2.

ment on the physical experiments of Plateau on soap films, he deduced that the figure must be a curved 14-hedron similar to the planar, so-called orthic, 14-hedron. The planar 14-hedron can fill space, and for the same volume has less area than the rhombic dodecahedron, but its angles are not 120°.[2] By means of the Calculus of Variations Kelvin determined the form of this curved polyhedron of minimal area.

This problem interests greatly the biologists by its relation to the shape of cells in animal and plant tissues, in particular bean cells. Nevertheless, some biologists appear to doubt that the minimal 14-hedron of Kelvin has less area than the planar 14-hedron. Dr. Frederic T. Lewis, of the Harvard Medical School, who has studied the problem deeply and has been much interested in the solution, told me of this uncertainty as to the true solution. In order to dissipate the doubt of the biologists, I have not calculated the area of the 14-hedron of Kelvin, which would be quite a laborious task, but have constructed another curved 14-hedron with the same volume as the planar 14-hedron, and which has less area.

The form of construction, starting from the planar 14-hedron, is the following: in the plane of the square face with coordinates such as are indicated in Fig. 2, one takes a curve $y = k\,f(x)$ such that $f(-x) = f(x)$, $f\left(\frac{l}{2}\right) = 0$. One constructs a conical surface with vertex in the center of the adjacent hectagon with the curve as directrix. If one repeats this operation with all the edges of all the squares, the figure that one obtains has the same volume as the planar 14-hedron and can fill all space, as one sees easily from the symmetry of the figure (having all the symmetries of the planar 14-hedron). Its area will be a function of the parameter k, and to determine its minimum value is a very simple problem. For the demonstration, I have taken $l = 2$, and $f(x) = 1 - x^2$. The area is given by the formula

$$A(k) = 24 + 32\,k + 24\int_{-1}^{+1} \sqrt{3 - k\,[2(1+x^2) - k(1 + 10\,x^2 + x^4)]}\,dx$$

Since

$$\sqrt{a^2 - b} = a - \frac{b}{2a} - \frac{b^2}{2a\left(a + \sqrt{a^2 - b}\right)^2};$$

and neglecting b in the denominator of the final term, one finds that the value of k which gives the minimum area is $k = 0.044$. Observing that

$$(2-k)k \leqq k[2(1+x^2) - k(1 + 10\,x^2 + x^4)] \leqq (4 - 12\,k)k$$

for $-1 \leqq x \leqq 1$, one finds the area of the figure is:

$$A = 24 + 48\,\sqrt{3} - 0.1106 \pm 0.0001$$

which is 0.103 per cent. less than the area of the primitive polyhedron.

Dr. George D. Birkhoff has inquired concerning the interesting case $f(x) = 1 - |x|$ in which one has a polyhedron of 54 sides (but only 14 faces) which presents the required space-filling characteristics and for $k = 0.059$ is 0.086 per cent. less area than the original 14-hedron.

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[1] See Sir W. Thomson, "On the Division of Space with Minimum Partitional Area." *Philosophical Magazine and Journal of Science*, vol. XXIV (5), 1887.

[2] For exact dates and careful description, see D'Arcy W. Thompson book "On Growth and Form," Cambridge (Eng.) at the University Press, 1942.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPLICATION OF THE CONTROL CHART METHOD TO THE ANALYSIS OF FISHERIES DATA

IN a paper now in press as a Bulletin of the U. S. Fish and Wildlife Service[1] the writer has discussed the downward trend of the catch of Columbia River Chinook salmon since 1920 and has stated that the decline is doubtless an indication that the runs of this species are seriously depleted. Recently the same data have been studied by means of the control chart method and the results show so clearly that the productivity has dropped to a new and much lower level that it has seemed worth while to present a brief note amplifying the discussion in the bulletin.

The statistical analysis, or control chart, as developed by Shewhart,[2,3] Deming,[3] Simon[4] and others, has been applied chiefly to the control of quality of manufactured products but the same methods can be used in the analysis of other types of data, especially those involving time series. This application to the annual catch of Chinook salmon illustrates the value of the method in the field of fisheries biology.

Fundamentally the method has much in common with the analysis of variance and, in its more common application, involves systematic observations of a selected character and continuous analysis of the variations. It provides a convenient and rapid way of discovering the presence of heterogeneity in data, the causes of which, on further study, may be identified. The processes involved may then be controlled in the direction of the elimination of causes of undesired variability or, conversely, in the direction of the development of the causes behind an improvement. Ingenious tables facilitate the computations involved and the simple graphs used present the results in such a way that they may be readily extended, promptly analyzed and interpreted.[5,6,7]

Fig. 1 presents a series of graphs resulting from the application of this method to the analysis of the annual catch of Chinook salmon in the Columbia River

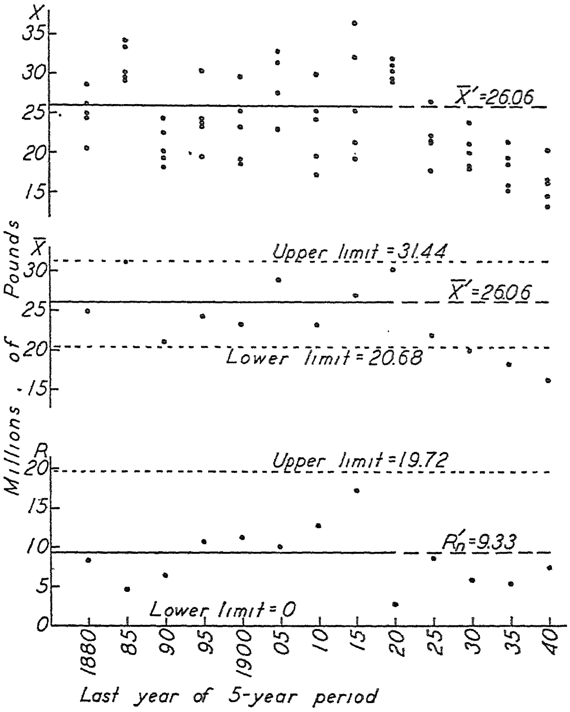

FIG. 1. Annual catch of Chinook salmon, Columbia River, 1876–1940. Analysis by control chart methods using the years 1876–1920 as standard.

from 1876 to 1940 (except for 1901, for which no data are available). The data are in pounds (estimated from pack data) and have been taken chiefly from Craig and Hacker[8] and from the Yearbooks of the Pacific Fisherman. The years have been grouped by 5's, making 13 groups which may be considered as consecutive samples. The ordinates in Fig. 1 correspond to these 5-year periods and the points on these ordinates show (1) the catch of each year in the period (X); (2) the mean annual catch for the period ($\overline{X}$); and (3) the range of the annual catches within each 5-year period (R).

Previous inspection of the data, particularly of the 5-year averages, had shown that the period since 1920 had been marked by a constantly reduced catch and, for this reason, the period from 1876 to 1920 was taken as the standard with which the catch for the years since 1920 was to be compared. The average catch during the 45 years from 1876 to 1920 was 26.06 million pounds, which is shown as the central, horizontal line in the X and $\overline{X}$ panels (labeled $\overline{X}'$). The average range of the catches during each 5-year period was 9.33 million pounds and is shown as the

[1] Willis H. Rich, "The Salmon Runs of the Columbia River in 1938." Contribution No. 7, Department of Research, Fish Commission of Oregon.

[2] W. A. Shewhart, "Economic Control of Quality of Manufactured Product." D. Van Nostrand Co., 1931.

[3] W. A. Shewhart, "Statistical Method from the Viewpoint of Quality Control." Edited by W. Edwards Deming. The Graduate School, Department of Agriculture, Washington, 1939.

[4] Leslie E. Simon, "An Engineers Manual of Statistical Methods." John Wiley and Sons, 1941.

[5] "Guide for Quality Control, Z1.1–1941," American Standards Association.

[6] "Control Chart Method of Analyzing Data, Z1.2–1941," American Standards Association.

[7] "Control Chart Method of Controlling Quality during Production, Z1.3–1942," American Standards Association.

[8] Joseph A. Craig and Robert L. Hacker, *Bulletin, U. S. Bureau of Fisheries,* No. 32, 1940.

central line in the R panel (labeled R'_n). The upper and lower limits as shown in the $\overline{X}$ and R panels are the limits set by adding to and subtracting from the mean values of these statistics ($\overline{X}'$ and R'_n) three times an estimate of their standard deviations. The estimation of these limits has been made from tables given in reference 7 for determining the "control limits" from the ranges. Assuming that the values of $\overline{X}$ and R are normally distributed, the probability of an individual value falling outside these limits solely as a result of sampling error would be only about .003.

It is apparent from the figure that there has been no significant change in the variability within 5-year periods—the points in the R panel cluster well within the limits. This is true even of the last four periods. In the case of the mean values, however (panel $\overline{X}$), the points for the last three periods are all below the lower limit and that for the period immediately preceding (including the years 1921–1925) is not far above the lower limit. The obvious interpretation is that the mean catches for at least the past three 5-year periods are significantly different from those of the period 1876–1920. If such a series of points outside the "control limits" were observed during the course of producing a manufactured product it would be taken as clear indication that something had gone wrong with the process and that things were getting rapidly worse. Even a single point outside the limits would be viewed with suspicion and an investigation started. There seems to be no reason to make a different interpretation of the data bearing on the runs of Columbia River Chinook salmon.

If such a control chart of the production of Chinook salmon on the Columbia River could have been presented in 1930 it would have shown that the 5-year period ending with that year was "out of control" and this should have been taken as a warning that something was wrong with the production process. As a result investigations could have been started to determine the causes of the reduced productivity and measures taken that might have prevented or at least delayed the progressive depletion that followed. As a matter of fact the need for such action was not felt because the true situation was not generally recognized. The catches had been small for a few years, it is true, but there had been poor years before and fishermen, canners and fisheries administrators alike took counsel of their hopes and looked forward to a return of the better catches that had prevailed so long. An occasional biologist recognized the danger and as early as 1925 the writer made the following statements: "The pack . . . has remained practically stationary for a number of years during which time the intensity of fishing has been increased. . . . We may assume, therefore, that the present intensity of fishing is too great and is resulting in a dangerous reduction of the reserve of breeding adults." And suggestions were offered for minimizing "the danger of seriously depleting the supply of fish before some indication of the imminence of such depletion has become apparent."[9] In the light of present knowledge it would appear that a control chart of the sort now available would have given exactly the sort of information that was needed.

If such information had been available in 1930 and if the production of Chinook salmon had been a commercial venture under statistical control is it too much to think that something effective might have been done promptly toward maintaining production at a higher level? It seems altogether probable that the low average level of the catches in the 5-year period ending with 1930 would have been a "basis for action." The scientific management of fishery resources is not quite so simple as maintaining quality in a production line of a factory but the importance of maintaining productivity of biological natural resources is much greater on account of the serious losses that result from depletion and the long time required for rehabilitation of once depleted resources.

This control chart method of statistical analysis may well prove to be of rather general application in biology and particularly in the management of fishery and wildlife resources. It is concise, positive, easy to apply and points out variations due to heterogeneity of data promptly while there is still a chance that the causes are still operative and can be identified.

WILLIS H. RICH

FISH COMMISSION OF OREGON AND
STANFORD UNIVERSITY

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SCIENCE NEWS

Science Service, Washington, D. C.

CLIMATIC CONDITIONS IN NEW GUINEA

THE approach of spring in the northern hemisphere will have little effect on the importance of New Guinea in the Pacific warfare. New Guinea lies too close to the equator to have marked seasonal changes. It is summer there all the time. The extreme northern point of the island is just to the south of the equator, the southern extremity is only 12 degrees south of it.

The snow-capped mountains in New Guinea prevent the high temperatures that one might expect so near the center of the torrid zone. A high mountain range extends almost from end to end of the island. It has many high peaks, several over 15,000 feet in height, and two at least with glaciers. There are lower ranges to the north and south. The coastal regions are the hottest parts of the country. They are covered with dense tropical jungle. On the higher mountain slopes and plateaus the vegetation is more like that of Europe and America. Above the snow-line, at an elevation of 14,500 feet, little or no vegetation exists. Except on the low coast lands and on the high mountains the temperature ranges from 72 to 92 degrees Fahrenheit daily, with very little variation throughout the year.

New Guinea is the largest island in the world, if Australia and Greenland are regarded as continents. It is approximately 1,500 miles in length. In area it is nearly three times the size of the British Isles. It contains an area about equal to that part of the United States north of the Potomac and Ohio Rivers and east of the Mississippi, not including Michigan and Wisconsin. It is even larger than Texas—about 20 per cent. larger.

In outline New Guinea resembles somewhat a gigantic lizard, looking westward, with its head almost touching the equator. Its shoulders are slightly hunched in the direction of Japan. Its tail, the part called Papua, extends toward the southeast, ridging up into the Owen Stanley Mountains. Port Moresby is on the south side, Buna on the north.

It is a sparsely populated country, with about as many persons in the entire area as are now in the District of Columbia. The population is estimated to be less than a million, of whom only about 10,000 are Europeans. The rest are mostly natives. Among them are some of the most primitive people in the world.

Agriculture and mining are the principal industries. Coconuts, cacao and coffee are the largest agricultural exports. New Guinea furnishes a considerable portion of the world's supply of gold. Natives are employed in the gold fields.

From Cape York Peninsula, Australia, it is but a hundred miles across the shallow Torres strait to the southern coast of New Guinea, and about 300 miles northeasterly to Moresby. From Moresby to Buna is approximately 100 miles by air, but considerably more by the circuitous route over and through the Owen Stanley Mountains.

New Guinea is cut up into three political divisions. The western half belongs to the Netherlands. The two

s developed to measure radioactiv-
mixture containing potassium is
without the assistance of an
eastern divisions are under Brit special glass cell which sur-
part of it is Papua. The no tube. The tiny impulses
neighboring islands are under Aus s in the potassium atoms

Papua has about 90,000 square m apparatus.
2,500 Europeans and 275,000 natives
east New Guinea, together with the B
mon Islands, includes 70,000 square miles has become a
and 23,300 square miles additional on the isl
capital is Rabaul, on New Britain, at present occupied by the Japanese. Its population includes about 6,000 Caucasians and 500,000 natives.

THE PROBABLE SPREAD OF TROPICAL DISEASES

A WORLD-WIDE spread of tropical diseases can be expected after the war, was stated by Colonel Thomas T. Mackie, of the Army Medical College. He described the problem at the National Conference on Planning for War- and Postwar Medical Services held in New York City March 15 under the auspices of the Carlos Finlay Institute of the Americas.

The present war, Colonel Mackie said, is unlike any in history in the enormous potential hazard of disease to which populations may and probably will be exposed. The peak of the hazard will come after the war as armies that have become reservoirs of disease return home and as masses of people in oppressed and disease-ridden countries emigrate.

Besides furnishing food and clothing to relieve malnutrition, semi-starvation and destitution, the United Nations will be faced with the "imperative need for the effective control and treatment of disease" in occupied nations. Public health practice and the practice of clinical medicine will be affected in many parts of the world by the expected extensive migration of tropical diseases.

Tropical diseases do not stay in the tropics because of the climate. Malaria can and does occur in such far northern regions as Canada and the British Isles. Even such a strictly tropical disease as filariasis, popularly known as elephantiasis, has existed near Charleston, S. C.

Sanitation and personal hygiene are more important than climate in keeping these diseases out of temperate regions. But they can spread wherever mosquitoes, ticks or other insects that carry the germs exist, and many kinds of insects capable of carrying tropical disease germs are widely prevalent all over the world. Other kinds, never before known to carry these germs, may acquire that ability. Constant air transport between widely separated theaters of war may accidentally spread widely both disease-infected persons and the mosquitoes or other carriers of the disease.

SUNFLOWER-SEED OIL

SUNFLOWER-SEED oil, which may be obtained in large quantities from certain varieties of the common sunflower, is a possibility in the United States to help to fill the shortage in edible oils due to war conditions.

Imported olive oil, which came from Spain, France, Italy and French North Africa in pre-war days, is now available only in small quantities. Peanut oil and cottonseed oil are demanded in great volume for war purposes. Russian sunflower-seed oil is no longer obtainable. Argentine oils are filling only part of the need. Sunflower-seed oil produced at home would save shipping, supply the demand and develop a new source of income for the American farmer in post-war times.

American sunflowers grow luxuriantly in much of the country. Much of the seed finds its way into commerce, but largely as bird and poultry feed. Missouri raises the largest commercial crop, even exceeding Kansas where the sunflower is the state flower. California is also raising the seed for market.

Oil from sunflower seed was produced commercially in the United States a generation or so ago on a relatively small scale. The industry was discontinued because of the high labor costs when compared to labor costs in the other countries producing edible oils.

Dr. G. S. Jamieson, of the U. S. Department of Agriculture, states that land suitable for corn is suitable for sunflowers. The crop can be planted and cultivated with the same implements. New mechanized methods of harvesting, threshing and processing will make it a profitable crop for oil as well as for poultry feed. Argentina is showing us the way this can be done. It is now producing large quantities of sunflower-seed oil and shipping much of it to the United States. In 1932 it produced only about 5,000 tons. The Spanish War cut off Argentina's supply of olive oil, and it started to raise its own table oils from peanuts, cottonseed, rapeseed and sunflower seed. Now the amount made from the sunflower far exceeds that from all other sources together. According to the U. S. Department of Commerce, it is nearly 500,000 tons a year, one fourth of which is being sent to this country.

POTASSIUM IN FERTILIZERS DETERMINED BY RADIOACTIVITY

RADIOACTIVITY is now being used to determine the amount of potassium in fertilizers and other mixtures. The new method may completely replace the old chemical analysis method, until now the only general method in use. This is a laborious task taking hours to complete. The radioactivity method requires but a relatively short time. It is claimed to be accurate.

Radioactivity is a property possessed by certain substances, such as radium, of giving off spontaneously special rays or radiations that are invisible to the eye but which will pass through materials through which ordinary light will not pass. Potassium mixtures and compounds possess this property to a slight degree. In the new method the quantity of potassium present is determined by the intensity of the radioactivity of the mixture. The radioactivity is weak, but is measurable by extremely sensitive modern physical instruments.

The new method is the result of work by Dr. R. Bowling Barnes and Dr. D. J. Salley, of the American Cyanamid Company. A report on it was published recently by the American Chemical Society.

In the new method an instrument known as the Geiger counter is used. It was developed to measure radioactivity. The sample of the mixture containing potassium is dissolved in water, with or without the assistance of an acid, and introduced into a special glass cell which surrounds the Geiger counter tube. The tiny impulses caused by the radioactive changes in the potassium atoms of the sample actuates the counting apparatus.

ITEMS

THE city of Washington, D. C., which has become a crossroads for most of the world as well as the forty-eight states, enjoyed the healthiest year in its history during the first year of the present war, 1942, according to Dr. George C. Ruhland, District of Columbia health officer. Dr. Ruhland reported that: The infant mortality rate, one of the best indices of health in a community, was the lowest of all time, 44.6 infant deaths per 1,000 live births. The latest available national infant mortality rate was 45.3 in 1941. Maternal deaths dropped to 2.2 per 1,000 live births, compared with a national rate of 3.2 in 1941. The death rate from all 10 major disease causes of death except diabetes decreased during 1942. The general death rate of 10.8 per 1,000 population is the lowest in the history of the District of Columbia, having dropped from 11.8 in 1941. The birth rate of 25.1 per 1,000 population, with a total of 21,317 new Washingtonians arriving since Pearl Harbor, is the highest in at least 50 years.

MENINGITIS cases throughout the nation in the week ending March 6 reached the highest figure for any week since 1927. This does not include any cases in Indiana, still unreported, but does include 25 delayed case reports from the previous week. For the first nine weeks of this year the total number of cases has reached about 3,500. This figure, recorded in less than one fourth of the year so far, is one third of the total reported in 1929, when a total of 10,551 cases with 4,781 deaths was reported. No figures on deaths from meningitis this year are as yet available, but it is believed the sulfa drugs are saving many lives in the present outbreak. The peak of this outbreak should come some time this month, meningitis being a winter and spring disease chiefly. Last year, however, the number of weekly cases continued at a high level throughout the summer and early fall. It is impossible to predict whether that will happen this year. The outbreak is concentrated chiefly in the states along the Atlantic and Pacific coasts.

NYLON sutures will be used by surgeons this year to sew war wounds, replacing Jap silk formerly used, E. I. du Pont de Nemours and Company have announced. Millions of feet of the plastic filament formerly produced for tennis racquets and fishing leaders are now being made for surgical sutures and large quantities are being shipped to the medical deposits of the United Nations throughout the world. Nylon filaments are solid strands, in contrast to braided silk sutures. It is claimed that germs from infected tissue are not absorbed and can not travel through the nylon as sometimes occurs in braided material. The synthetic is also inert, non-irritating and does not fray or splinter. Satisfactory results have been reported from England where nylon sutures have been widely used on the victims of bombing.

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OUR JOB AHEAD[1]

By Professor RICHARD BRADFIELD

HEAD, DEPARTMENT OF AGRONOMY, CORNELL UNIVERSITY

THERE has been considerable discussion of the advisability of holding our annual meeting this year. Some saw the physical difficulties involved and favored cancellation. The majority, perplexed by the numerous new problems confronting them as a result of the war, felt even more keenly than normally the need to talk over their problems with their colleagues in other institutions. All felt that to justify a meeting at this time especial emphasis should be placed upon problems connected with the war. Such problems have been the dominant theme of our program.

To-night, I shall exercise my prerogative as your President to speak to you about the job that lies ahead of us as agronomists in the post-war world. My remarks are based on the premise that the war will end eventually in a victory for the United Nations. I would not care to think about any other type of post-war world.

I think I can justify speaking about post-war problems in the midst of the war. This is a war of ideals. We need a clear conception of what we are fighting for, if we are to put our best efforts into the war. We need to express our objectives clearly so that the rest of the world can know what they are and can support us if they believe as we do. The problems of the post-war period will be just as difficult, possibly even more difficult, than those of the war. Internal dissension tends to disappear during a war. It will tend to rise again after the tension of war eases and we begin to consider the superficially

[1] Presidential address, American Society of Agronomy, St. Louis, Missouri, November 12, 1942.

less urgent problems of peace. The necessity of war was obvious after Pearl Harbor. The maladjustments of peace may fester for a generation before erupting. We won the last war but lost the peace. We must make this victory complete!

If the victory is to be complete and the peace a lasting peace, it is none too early for all of us to be thinking about it. It is well to have special post-war planning boards to work out details, but in our democracy, the final word is with the people. Our leaders will be helpless unless they have a clear mandate from the people. And finally, if these are not sufficient reasons for speaking about post-war problems in the midst of war, I shall confess that I am, by nature, an idealist, a day dreamer, one of whose joys in life is to plan for a better world.

As agronomists, we all recognize the importance of environment on the course of development of all living organisms. Before considering the problems of the agronomist in the post-war world directly, let us first consider briefly some of the factors in the post-war environment in which he must work. Both the physical and the social-economic-political factors of the post-war environment will be quite different from those of the pre-war world. How different in detail remains to be seen, but certain dominant aspects are clear.

On the physical side, we know that this is a war in which machines have played a more important role than ever before. "Too little and too late" has resulted in defeat after defeat for the United Nations. We have now come to realize that to win this war will require the most Herculean effort ever made by the American people. That "battle of production" is being won.

In his inspiring address before the American Chemical Society in September, Stine[2] pointed out that "the pressures of this war are compressing into the space of months developments that might have taken us a half-century to realize if necessity had not forced the pace.

"Those pressures are unprecedented. The developments are unprecedented. Give us a victorious peace and the freedom of enterprise it should guarantee and our progress will be unprecedented. One does not need to venture into prophecy to sketch the bold lines of what that progress can be. They have already been traced. Already our world of 1940, in which we took such pardonable if mistaken pride, is so distant in the past that it has become an antiquity, as seen through scientific eyes. The inconceivables of two years ago are to-day's realities."

A few specific examples cited by Stine will clarify the picture. The crude rubber production of the world was raised to a million tons a year in the last century. We expect to develop a like capacity for synthetic rubber production in the United States alone in the next two years. In 1943, our production of aluminum will be almost seven times that in 1939, which was over fifty years after Hall's discovery of the electrolytic process for its manufacture. This capacity will be sufficient to build in one year three times the number of passenger cars now operating on all American railroads.

By the end of next year, we shall be producing one hundred times as much magnesium as we produced before the war. In 1915, it was worth $5.00 a pound. To-day, it can be produced for 22½ cents! This makes it even cheaper per cubic foot than aluminum!

We were already referring, before the war, to the years immediately ahead as "the age of plastics." At the end of the war, the newest and most versatile of the plastics will be available on a scale beyond all previous conceptions. Our iron and steel capacity, already ample for all pre-war requirements, is being greatly expanded and will doubtless be more than sufficient to meet all post-war needs. The large scale development of improved alloy steels will be invaluable for many specialized needs.

Synthetic fibers of a great diversity of properties will be available in abundance. The synthetic organic chemist will be prepared to supply scores of new organics at new price lows. Motor fuels that promise to deliver fifty per cent. more power than the present 100 octane grade will be available. There has been a great increase in our capacity to produce electric power. Our machine tool industry has been vastly expanded. We have more men trained to operate them than ever before. In short, we shall have the raw materials, the power, the machines, and the trained men to perform the feats of industrial production of which men have long dreamed. This must suffice for the physical aspects of the picture.

Let us next take a glance at the prospects in the social field. President Roosevelt has said that we are fighting for four freedoms—freedom of speech, freedom of religion, freedom from fear and freedom from want. In the United States, we have all enjoyed the first three of these freedoms as our birthright. But while there has been less want in the United States than in any large country in the world, millions of our people have known want even in the last 25 years. Freedom from want for the common man throughout the world will prove the most difficult of all the freedoms to provide. That freedom can not be won on the battlefield nor at the peace table. Winning the war and writing the peace can set the stage. The widespread approval accorded Vice President Wallace's designation of the century ahead as "The Cen-

[2] Charles M. A. Stine, SCIENCE, 96: 305–11, 1942.

tury of the Common Man" is, I think, an indication that the American people, at any rate, are willing to strive for freedom from want. At the Eighth Scientific Congress in Washington in 1940, Tolley[3] declared that "a central problem of our generation is that of bringing to the people at large the great potential blessings that science has created in the last century." A similar opinion has been expressed by many other qualified scholars.

The satisfactory solution of this problem will require the sympathetic cooperation of all the people. We are learning to pull together during the war; we must continue to do so after the war. None of us should expect to have his wants handed him on a platter. Each must learn to contribute his share to the nation's and to the world's stockpile. There is an unprecedented demand for technically trained men to win the war. They will be needed just as much to win the peace. Scientists must come to grips with the intricate and, as yet, unsolved problems of distribution as well as production. The public must come to realize that, while it may be costly to keep our industrial and agricultural machinery running, it will be costlier still to let it stop! The last Depression is still close enough to serve as a mild warning of what could happen.

In brief, it seems to me that the evidence at hand indicates a widespread approval of the ideals expressed in the Four Freedoms by the leaders and by the people of the United Nations. The most difficult of the freedoms to attain is freedom from want. The social, economic, and political problems involved are intricate and difficult but not hopeless. While physical resources seem ample, many important production problems await solution.

So far, I have attempted to set the stage. Let us now consider the role the American agronomist should play on this new, post-war, world stage. I say world stage advisedly, for I am convinced that the post-war services of American agronomists will not be confined within the United States.

I shall use the term "agronomist" in the same sense that it is used in our society. I conclude from reading our constitution that an agronomist is one interested in increasing and disseminating "knowledge concerning soils and crops and the conditions affecting them."

The primary "wants" of mankind are food and clothing. Both of these are directly or indirectly products of the soil and, hence, of concern to the soil scientist. Both are also dependent, directly or indirectly, largely on field crops and, hence, of interest also to our crops specialists. In broad, general terms, we are largely responsible for the technical developments in the production of mankind's "bread and butter." I shall leave the salad and a part of the dessert to the horticulturists! Because of the very basic nature of our specialty, agronomists and agriculturists, in general, will have unprecedented opportunities to help in shaping the future of society.

Let us first consider briefly our domestic problems. The agronomist's chief responsibility in this connection is to help the farmer develop principles and practices which will enable him: first, to produce enough food, feed, and other crop products of high quality to meet all demands; second, to improve his efficiency of production so that his products can be sold at a fair price and still yield a fair profit; and third, to maintain the productive capacity of his soil. We shall need to consider each of these points in a little more detail.

We are just beginning to emerge from a period in which several important crops, wheat and cotton in particular, were produced in much larger quantities than we were able to consume or sell at profitable prices. The demands of the Lend-Lease program are gradually reducing the surpluses of most commodities, and rationing of other products is already under way. There seems to be little question of our ability to produce in this country adequate amounts of all of the principal crops suited to our diverse climate. There is evidence of need of some adjustment in the types of crops produced in order to bring the supplies more in line with the requirements of an adequate diet for our entire population. Considerable attention is being given to the possibilities of industrial utilization of agricultural waste products and surpluses. There will doubtless be some progress in that direction. Agriculturists should keep in mind, however, that the modern industrial chemist can destroy markets for agricultural products as well as create them. Just imagine that you owned a rubber plantation in the East Indies, and I think you will see what I mean!

Before the war, our export market for most agricultural products had sunk to an all-time low. There seems to be little evidence to indicate that it can be regained in a world at peace. I see little reason to doubt that we can produce in this country all the agricultural products that we can consume or that we can hope to sell.

This does not mean that our job is done. It merely indicates that our major peace-time problem is not that of increasing our volume of production. Much can be done to increase the diversity and to improve the quality, particularly the nutritional quality, of our foods and feeds. Our people are more interested in adequate nutrition than ever before. The high nutritional standards in our armed forces will doubtless do

[3] H. R. Tolley, *Proc. of 8th Am. Sci. Congress,* Vol. 5, p. 279. 1940.

much to improve the food habits of the men when they return to their homes. Better tools for assaying the nutritional value of foods have been developed and are rapidly being improved and simplified. We know but little about the effect of various environmental factors upon these different quality factors in foods and feeds. Different genetic strains of crops differ widely in the content and nature of their vitamins, fats, proteins, and carbohydrates. They offer the plant breeder an almost virgin field in which to exercise his talents. In the future, yields of dry matter and protein content will not be accepted as adequate criteria for judging the relative value of any given agronomic treatment or of a new variety or strain.

I have often been impressed by the wide range in the production cost figures obtained by farm management specialists for different farmers in the same community. Some of our New York farmers can produce 100 pounds of milk for half what it costs their neighbors. Even in the midst of the depression, a few farmers managed to make a little money. Increased efficiency of production of crops is a goal that the agronomist should keep constantly before him. I can think of no circumstances under which the farmer is liable to suffer because his production costs are too low. Economical production is sound in peace or war, in prosperity or depression. In the competition for a market, everything else being equal, the most efficient producer will win out whether the competition is between neighbors, between regions, between products, or between a domestic and a foreign producer. Artificial subsidies and barriers may bolster the inefficient producer temporarily, but it is futile to rely upon them as a permanent policy.

When I try to analyze in detail the various steps involved in crop production, there does not seem to me to be a single step that we can sort out and say, "This step is perfect. Nothing can be done to improve it." Processes which we may regard as satisfactory to-day may be challenged to-morrow in light of new information. I was taught that one of the important objects of plowing was to cover crop residues. Now, many agronomists are trying to find out how to plow without covering the "trash." Much of our farm machinery is in the same stage of development as the early automobiles with a dashboard and whip socket. Machines designed 50 years or more ago for operation with horses have been slightly altered to adopt them for use with the tractor. We need to make a thorough study of all the operations required in growing a crop from seedbed preparation to harvest, and after we have decided what operations are necessary for the most efficient production, we should solicit the assistance of the agricultural engineer and the farm machinery manufacturer for designing and making the implements required. They can not do their job until we have done ours. A few years ago, we were dissatisfied with the fertilizer distributors on the market. A complaint was made to the agricultural engineers. They asked us where we wanted the fertilizer placed with respect to the seed. We had to admit that we did not know but agreed to find out. Our joint committee on Fertilizer Application was set up. Cooperative experiments involving many crops, many soils, and many climatic conditions were carried out. Within a couple of years, the engineers were given their answer, and the next year, improved fertilizer distributors were available. Many farm machinery manufacturers are now using their factories for making war machines. The time would seem propitious for getting the basic information necessary for the intelligent redesigning of farm machinery. Far-sighted leaders in the field are already at work on the problem and, I am sure, would welcome the suggestions of agronomists.

The most important factor affecting crop yields in this country is still the weather. It is far more effective than any legislative control program. Many prospective agronomists are now studying meteorology in connection with the air service. They may be able to do something with the weather when the war is over. Even if they fail us, and the post-war weather remains uncontrollable, I feel that the agronomist should be able to help the farmer become more independent of the vagaries of the weather. There was a heavy hay crop in much of eastern United States this year. But the heavy rainfall, responsible in a large measure for the heavy hay crop, continued during hay harvest. As a result, much of the hay rotted in the field and much of that saved was seriously damaged by the rain. Shall we always be so helpless? Shall we always, under such circumstances, have to risk the loss of a crop which requires a whole season to grow just because we do not get an additional eight to fifteen hours of sunshine at harvest time?

Several possible solutions are being studied, grass silage, artificial drying, and barn curing; all these seem worthy of further investigation and of more widespread farm trials.

As a direct result of the war, the capacity of our synthetic ammonia plants has been enormously increased. There seems little question but that after the war there will be available for use as fertilizer at least twice as much nitrogen as we have ever used and at a price much less than we have ever paid. A national joint committee, made up of representatives of several interested organizations, has been set up to consider the possible agricultural uses of this material.

Many of you participated in this conference held in connection with this meeting. The possible industrial and agricultural implications of this development are considered by some industrial leaders large enough to have an effect on our post-war economy, "comparable to the discovery of a sixth continent."

When we consider what most of our pastures are and contrast that with what they could be, when we think of how the lespedeza rotations have affected the agriculture of Missouri and neighboring states in the last few years, when we think of what hybrid corn has done for the corn belt in the last decade, when we consider what a small percentage of the plants in the world we have tried seriously to introduce into our agriculture, I'm sure we would all agree that there is still much the agronomist can do to help the American farmer increase his efficiency of production.

I am also convinced that American agronomists have a very important international service to perform. The world seems much smaller than it did two years ago and many of its distant lands much closer to us. When the war is over, there will be millions to feed, large communities of people to be resettled, and farms to be supplied with seed, fertilizer, machinery, and livestock. A roster of qualified personnel for assisting with such work is already being prepared.

In addition to these emergency problems at the close of the war, there will be a need for American agronomists to help many countries with a primitive agriculture and, in many cases, a population larger than it can support at a satisfactory level. After long experience in public health work in such countries, the leaders of some of our large philanthropic foundations have become convinced that the best way to improve the health and general well-being of such people is to first improve their agriculture.

A high proportion of the world's farm population is still using techniques that were in use in Biblical times. Contrast the human effort that goes into the production of a bushel of wheat on one of these primitive farms with that in our wheat belt. To prepare the seedbed, the soil is "tickled" three or four times with a wooden plow drawn by a pair of oxen, the seed is broadcast by hand, the wheat is harvested by cutting one handful at a time with a sickle, it is then carried or hauled to the threshing floor, often the bare ground in an open field, where it is threshed with a flail or by treading with animals! Think of doing all this work for an average yield of eight bushels of wheat per acre! Yet wheat is being grown in this way by thousands of farmers within one day's flying time from here!

American agronomists can be of great service to the governments and educational institutions of such countries. The movement was spreading before the outbreak of the war. It will be resumed at accelerated speed after the war. Foreign students, in increasing numbers, will come to our shores for special training. Scholars from all countries should be made welcome. I hope our price level can be kept in close adjustment with that in other countries so that travel and study in America will not be beyond the reach of the ambitious young people in other countries. I would like to see our American universities far outrival the German universities of half a century ago in their influence upon science and upon the thinking of the world.

And why not? We have or can have the same academic freedom of which they were once so proud. We have or can have an equal quality of intellectual leadership. We have or can have physical facilities for research which will be unsurpassed in any country. I would have the scholars of the world love America. I would have them go back to their countries and instil some of that love of America in their students and other countrymen. Such friends would be America's strongest armor, her best insurance for a lasting peace. Can you conceive of any investment that would yield greater returns to America in the way of international understanding and good will than the education of a Madame Chiang Kai-Shek?

The soil scientists of America had made a good start toward better relations with their colleagues in other countries, even before the war. Their International Congress, held in Washington in 1927, and the excursion throughout the United States which followed, gave many foreign scientists their first opportunity to study our soils and to become acquainted with us. The Second Congress in Russia in 1930 stands out in the memories of many of us as one of the outstanding treats of our professional careers. The seeds of the present conflict had been sown before our Third Congress at Oxford in 1935. An undercurrent of rumors and distrust was apparent to all. At the meeting of the Soil Microbiology Commission in New Brunswick, New Jersey, in August, 1939, a cordial invitation to participate in the Fourth International Congress to be held in Germany in 1940 was presented. The German Organizing Committee had, even at that time, planned with characteristic thoroughness every detail of the Congress and of the excursion to follow. A few days later, war was declared, and a few weeks later, the Congress was postponed. Many of the pioneers in this society will be missing when the war is over. New leaders must be found to take on the responsibility for its revival after the war. The job will require men of great tact and understanding.

It seems to me to be especially important for us to develop a better acquaintance and understanding with

our colleagues in Latin America. A start was made at the Scientific Congress in Washington in 1940 and at the Agricultural Conference in Mexico City this summer. These conferences should be followed up with a democratic organization of the agronomists of these countries.

There is in my mind no question about the enlarged opportunities for service and the responsibilities for leadership at home and abroad that will be within the grasp of American agronomists at the end of the war. The next question is: "Do we have the men to do the job?" A decade ago, the market for young agronomists seemed to be about saturated. Able young men, well trained, equipped after years of sacrifice with a Ph.D. degree, were doing odd jobs until a real job in their field was open. A little later, the Soil Conservation Service was established. Within a short time, it had a budget greater than the soils divisions of all other state and federal organizations combined, and it was scouring the country for men with some agronomic training. The demand for well-trained men continued keenly up until the outbreak of war. Now nearly every institution or organization employing agronomists has several vacancies on its staff. Many of us are gradually becoming reconciled to the idea that many of the vacancies will have to remain unfilled until the war is won. Some of us can get a little relief by hiring men away from other institutions, but such tactics will not help the over-all shortage and should probably be confined to the normal traffic.

The graduate student enrollment in most institutions is only a small fraction of normal. It will doubtless tend to get lower as long as the war continues. At the close of the war, many of those who were planning a career in some field of agronomy will return to our graduate schools. Many who have accepted "temporary" positions in defense industries will tend to lose touch with developments in agronomy and will probably remain in industrial work. In view of these facts, I am inclined to think that the demand for able, well-trained agronomists will exceed the supply for at least ten years after the war is over. The only thing that I can think of which would "glut" the market would be a very drastic reduction in the support given some of our federal agencies or state institutions.

Let us consider a little further the potential post-war demand for agronomists. There are never enough "top notch" men to satisfy the demand. The demand will be keener than ever after the war. We shall need a few dreamers, far-sighted men, who can see the paths we should take and lead us and the country at large to see the potentialities for mankind that lie hidden in our soils and crops. We are, as a whole, a rather practical group, tied rather closely to the conventional approaches to our problems. For those of us who have to deal daily with farmers and their practical problems of the moment, this is highly desirable. But if we are to break new trails, we shall need a few visionary men, men broadly trained not only in the basic sciences, but in the humanities as well.

A few days ago, I heard a nationally known farm leader say that he was going to resign from several important positions so that he could have time to think about some of these problems that are going to confront agriculture after the war. In his address to chemists referred to above, Stine said, "We are going to need to be visionary to the point of audacity." If agriculture is to keep pace with industry, agriculturists must be equally bold and farsighted.

I anticipate but a modest expansion in the number of agronomists on our college, university, and experiment station staffs. I will not even risk a guess about the future for agronomists in the United States Department of Agriculture. There is, however, another broad and practically virgin field in which the professional agronomist could render valuable service. I am convinced that a half-dozen or so extension agronomists will not be able to meet the demands for help from farmers of a large state which will arise after the war. There should be at least one professional agronomist available for consultation in every important agricultural county. In some counties, the county agent himself is qualified to handle the agronomic problems which come up in his county. More commonly, his own training is too limited, and the demands on his time are too numerous to enable him to do the work satisfactorily. These county extension agronomists would not necessarily have a Ph.D. degree. They should have a good farm background, a strong undergraduate major in agronomy, topped by one or two years post-graduate work in soils science, especially soil management, field crop production, farm management, and allied fields. They should be able to handle most of the individual farmers' problems. They would have the responsibility for supervising all agronomy demonstrations in their counties. Only the more difficult situations would be referred to the state extension specialist. The latter would function more largely through the county agronomy specialists in his region and through group meetings of farmers. Plans somewhat similar to this are already in operation in sections of the country. In areas where large farming corporations are operating, such organizations could well afford to have a professional agronomist on their staffs. I understand that the sugar planters of Hawaii have established systems of agronomic management and control much more elabo-

rate than I have outlined here, and they have found that it pays. Estates as small as 1000 pectares in East Prussia frequently have university trained specialists in agronomy and animal husbandry on their staffs. Our agriculture consists, and will probably continue to consist, largely of relatively small, individually owned and operated farms. Some expansion of the already firmly established county agent's staff would seem the most efficient way of providing this added professional service where it is needed.

I cannot refrain at this point from commenting briefly on the organization of agronomic work in this country. The great bulk of our research and teaching in agronomy is supported by public funds. The great majority of the members of our society are employed by county, state, or federal agencies. As public servants, there are two different points of view as to how we should conduct ourselves:

The first is that we should confine our activities strictly to our field of specialization. In other words, "stick to our last."

The other is that we, as specialists in the public service, have a certain definite responsibility for helping to develop public policy in the field of our specialization. Agronomists are still citizens and, as such, cannot escape the responsibilities of citizenship.

I feel that one of the most outstanding public services ever performed by an American soil scientist has been performed by Dr. H. H. Bennett. As a result of years of experience in studying soils, especially those of the south, he was convinced that something more had to be done to stop erosion, or the agriculture of large sections of our country would be seriously impaired. In just about a decade, he has succeeded in persuading Congress that something should be done about it, and he has made the country erosion-conscious. The nation unquestionably owes him a debt of gratitude. We need more men with his vision.

We have recently had numerous new agencies set up in the United States Department of Agriculture—many of them largely as emergency measures and presumably of temporary duration. As originally conceived, each had a rather distinct function to perform, a function which no existing organization was adequately handling. Being liberally supplied with funds, these organizations expanded rapidly. Many of them soon extended into every section of the country. Each is tending to become a Department of Agriculture within a Department of Agriculture. The result has been confusion, working at cross purposes, and friction. A very considerable proportion of the time of some of our ablest men in the agronomic field is spent in trying to iron out difficulties which should never arise. I am convinced that no intelligent man could study the existing organization of the work being done in this country in the broad field of soil science and field crop production and justify it. Agronomists in these various agencies are earnest and sincerely anxious to do their work well. I have no solution to offer. But I am sure that none of you, especially those of you with administrative responsibilities, could ponder over "our job ahead" without having this problem of the organization of our work appear as a very vital part of the task.

A few months ago, I wrote a friend in Germany, a soil scientist who has traveled in this country and is well known to many of you, that with our traditions of democratic freedom in America, we found it difficult to understand how the intelligent German people could submit to the tyrannies of Hitler. His reply was that with our bountiful resources in America we might be able to afford liberty and democracy but that Germany is a much poorer country and must be more efficiently organized to survive! I have thought of this letter many times since the outbreak of war. Is it necessary to sacrifice efficiency in order to maintain our democratic freedom? We will all have to admit that, at times, things seem to move much more slowly in a democracy. We do more cutting and trying, more experimenting, and more compromising. We give more weight to the views of minorities. This retards action, but I think we will all agree that it increases the probability that we shall come out with the right answer in the end. Let us hope that this applies to the organization of our agronomic work. Let us hope that the present confusion represents, from the long-time point of view, merely a transitory experimental stage which will lead soon to the development of an efficient, well-integrated program. Such a development is necessary if we are to fully discharge our duties to the public. It is necessary if our services are to be more effective in helping post-war agriculture vie with post-war industry in supplying the wants of mankind.

OBITUARY

GEORGE WASHINGTON CRILE

DR. CRILE was born in Chili, Ohio, on November 11, 1864, and died in Cleveland on January 7, 1943. He received his A.B. degree at Ohio Northern University in 1884 and his M.A. and M.D. degrees at the University of Wooster, 1887.

Dr. Crile served his alma mater as lecturer and professor of physiology and also as professor of clinical

surgery. In 1900 he was appointed professor of clinical surgery in Western Reserve University and became professor of surgery in 1911. In 1924 he retired in order to give his entire time to the Cleveland Clinic, of which he was a cofounder in 1921. After this clinic was fully established he devoted most of his time to travel and more general biological studies.

For Dr. Crile the road to surgery was through physiology—an association closely linked with his earlier teaching of this science. Also in those early years his extensive experience in traumatic surgery greatly stimulated his interest in the problem of surgical shock. No surgeon probably has had a keener and quicker appreciation of surgical risk, of how to handle living tissues and of the practical means for conserving the patient's natural resistance. To these ends through a very busy professional life of over 50 years he utilized to the utmost his unusual speed in operating, manual dexterity and technical training. Dr. Crile combined an unusual capacity for sustained mental and physical work requiring the highest skill with personal charm and leadership. Endowed with a physique far above the average he conserved this endowment to the utmost only to expend it lavishly for the advancement of his professional work. A typical day began at 8 A.M. with 6 or 8 major operations lasting until noon. He then spent an hour or more with his staff and visitors in his personally financed research laboratory. After lunch he handled his correspondence, went over research projects and data and took care of a busy consultation practice.

Dr. Crile was actively engaged in investigative work throughout his long surgical career. Early identified with the physiological problem of surgical shock for which he received the Cartwright prize in 1897, the Nicholas Senn prize in 1898 and the Alvarengo prize in 1901, he has made noteworthy contributions to its nature and to the methods for its prevention and relief. He was perhaps the first to make a direct transfusion of blood (1905) as a means of combatting this serious complication of physical and psychic trauma. Much of his experimental and clinical research in this field is to be found in his books on "Blood Pressure in Surgery" (1903), "Hemorrhage and Transfusion" (1909), "Anaemia and Resuscitation" (1914) and "Anociassociation" (with W. E. Lower, 1914).

His active and unusual mind gradually took him into more general fields of biological investigation and away from the strictly surgical problems of earlier years. Such monographs as "The Kinetic Drive" (1916) (Wesley M. Carpenter lecture), "A Bipolar Theory of Living Processes" (1926) and "The Phenomenon of Life, a Radio-Electric Interpretation" (1936) illustrate this phase of his activity and also aroused some criticism.

Dr. Crile was a member of many foreign and domestic medical societies, including those of the basic sciences, clinical medicine and surgery. He was an unusually regular attendant at most of the meetings of these societies and generally contributed papers or participated in discussions. He was a prolific contributor to medical journals and in addition published more than 25 monographs, including "Man, An Adaptive Mechanism" (1916), "Diseases Peculiar to Civilized Man," "A Mechanistic View of War and Peace" (1915) and "Intelligence, Power and Personality" (1941).

Many honors came to him. Honorary degrees were conferred by Hiram College, the University of Wooster and by the Universities of Dublin and Glasgow. He was president of the American College of Surgeons, a charter member of the Board of Regents and its chairman since 1917. He was a member of the founders group of the American Board of Surgery and in 1923 was president of the American Surgical Association.

Dr. Crile was the recipient of many medals, including American Medicine (1914), The National Institute of Social Sciences, the Trimble Lecturer medal, the Lannelongue International Medal of Surgery, the Cleveland Medal for Public Service and the Distinguished Service Gold Key of the American Congress of Physical Therapy.

In 1898 he was Brigade Surgeon in the Volunteers with the rank of Major and served in Cuba and Puerto Rico. In 1917 he organized and was professional director of U. S. Army Base Hospital No. 4 stationed in France. He was promoted to Colonel in 1918 and in 1921 to Brigadier General in the Medical Officers Reserve Corps. He was awarded the Distinguished Service Medal in 1919, became an honorary member of the military division, 3rd class, Commander of Bath, and in 1922 was made a Chevalier in the French Legion of Honor.

Dr. Crile married Grace McBride of Cleveland in 1900, who ably contributed to his career.

DAVID MARINE

MONTEFIORE HOSPITAL,
NEW YORK, N. Y.

HARVEY LEROY WESTOVER

HARVEY LEROY WESTOVER, in charge of the Alfalfa Project in the Division of Forage Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, U. S. Department of Agriculture, died in Washington, D. C., on January 2, of a heart complication. He was born in Austerlitz, N. Y., on June 4, 1879, the son of Seymour and Anna Gott Westover. He took his college work at Cornell, where he received his B.S. in 1906. He came to the U. S. D. A. that same year to the Office of Soil Survey, where he spent five years, then after devoting two additional years to

classifying soils for the Forestry Division he came to Forage Crops, as it was then called, in 1913. The division had been created in 1905 with a broad and important research program. The study of alfalfa was one of the principal lines of work and by 1913 it had progressed far enough to reveal its immense potentialities. The newcomer to the ranks was therefore assigned to the study of alfalfa—a study he was to follow with notable results until the time of his death. He and his crop grew in stature together. He worked in field and laboratory, he learned from books and from farmers in every section of the country where alfalfa is grown, he traveled across the world looking for better alfalfa, hardier alfalfa, disease-resistant alfalfa. He went to Argentina and Chile in 1924, to Russian Turkestan and Continental Europe in 1929, to Spain and North Africa in 1930, to Russian Turkestan and Turkey in 1934, and to Turkey in 1936. His persistent, systematic work, his faith and his loyalty were richly rewarded in his growth and the growth of the plant he studied. As years passed and the country grew and developed, deep, rich, green fields of alfalfa spread across the Northern Great Plains giving enormous and seldom-failing yields of hay and seed.

In the history of the world 1915 marks an epoch. World War I disturbed the established order of things and focused the attention of the farmer and scientist as well on the need for food crops. As a good deal of alfalfa improvement work had been done with emphasis on the factor of winter hardiness, and a group of superior varieties and strains had been developed, growers of the crop and breeders too turned their attention and talents elsewhere. Plants like humans suffer strange ills under crowded conditions and the fine fields of full-yielding alfalfa began to wither and die and no one knew why. The Department of Agriculture investigated and found that the disease was produced by a hitherto unknown bacterium that caused a malady they called bacterial wilt. Now that a diagnosis had been made the next and most important step was to find a remedy. The logical recourse seemed to be a breeding program. Westover set out and traveled the remote quarters of the globe gathering alfalfa in almost every country, seeking new varieties and strains that might prove resistant and save the enormous losses that were being sustained and that would eventually destroy the crop in certain localities. From Russia, from Turkestan, from Morocco, from Spain and from Continental Europe he brought seeds and plants and more seeds and plants until his collection grew to over a thousand different strains being grown with hope and skill in nurseries all over the United States.

In 1933 the Alfalfa Improvement Conference was created by scientists from all parts of the United States and Canada and logically Mr. Westover was elected the Permanent Secretary of the Executive Committee. In experiment stations all over the country the work progressed, the interest grew, hope was kindled and strangely coincidental is the fact that on the very day Harvey Westover closed his desk for the last time he had dictated the release of a new variety which had been called Ranger. Ranger is a composite of seed collected from various explorations, brought together, developed and tested at the Nebraska Agricultural Experiment Station and elsewhere. It promises to be what he set out to find—an alfalfa that can withstand bacterial wilt.

As Mr. Westover traveled over the world collecting alfalfa, he collected other seeds and plants along his way. Great packing boxes of these he sent back to the Department and these too are being carefully and hopefully studied and developed. He published many bulletins and scientific papers, not only on his major interest, but on other studies that he carried on in addition—silage, crested wheatgrass, root crops, lawns and fine turf particularly. During 1926–1929 he served as the acting chairman of the Greens Section Committee of the United States Golf Association. He was a fellow of the American Society of Agronomy and of the American Association for the Advancement of Science, and belonged to the Botanical Society of Washington, American Museum of Natural History, Explorers Club of New York and the Cosmos Club of Washington.

A tireless worker, no detail was too small for his consideration if it contributed to the thoroughness of his work. The exactness and excellence of his research is largely responsible for the role that alfalfa is playing in the farm program of the country. He was soft-spoken, modest and retiring. Wherever agronomists meet Harvey Westover will be remembered not only as a fellow-scientist whose contribution was outstanding, but as a valued friend. He had an extraordinary genius for friendship. He made friends wherever he went—be it to the steppes of Russia, the hills of Spain, or the ranchos of the Americas. That warm human quality was part of him and all who came into contact with him felt and responded to it. As Fitz-Greene Halleck said of his friend, I say of mine:

> Green be the turf above thee, friend of my better days
> None knew thee but to love thee, nor named thee but to praise.

Funeral services were conducted for him in Washington, D. C., on January 3, after which his body was taken home to the hills of New York to sleep the long sleep with those of his blood.

OLAF S. AAMODT
MARY BURR PIETERS
U. S. DEPARTMENT OF AGRICULTURE,
BELTSVILLE, MD.

RECENT DEATHS

BARNARD S. BRONSON, from 1908 to 1939 professor of chemistry in the State College for Teachers at Albany, N. Y., died on March 14. He was sixty-two years old.

DR. EDGAR BILLINGS, archeologist and geologist, who had been research associate of the University of Pennsylvania Museum, the Academy of Natural Sciences, Philadelphia, and the Carnegie Institution of Washington, died on March 18 at the age of fifty-six years.

DR. ROBERT HARCOURT, head of the department of chemistry of the Ontario Agricultural College, died on March 30 at the age of seventy-seven years.

COLONEL SIR SIDNEY GERALD BURRARD, F.R.S., geologist and geographer, Surveyor-General of India from 1910 to 1919, died on March 16 at the age of eighty-two years.

SCIENTIFIC EVENTS

BRITISH PARLIAMENTARY AND SCIENTIFIC COMMITTEE[1]

ACCORDING to the annual report for 1942 of the Parliamentary and Scientific Committee, the membership now includes thirty-three organizations associated with scientific work and seventy-four members of the Houses of Parliament. During the past year, the main work of the committee has been connected with the better utilization of scientific men in the war effort.

A memorandum on the subject was prepared and a strong deputation saw R. A. Butler, then chairman of the Scientific Advisory Committee. Later, a motion urging the establishment of a Central Scientific and Technical Board was tabled in the House of Commons. This motion was allowed to lapse, after several questions designed to elucidate the position had been asked in the House, on the understanding that the functions of the scientific advisers to the Ministry of Supply would be widened as they became established. The committee is watching the position. Discussions arranged during the year dealt with the dissemination of scientific knowledge among farmers, the Industrial Health Research Board, the use of geology in wartime, pasteurization of milk and visual efficiency in factories. The secretaries of the committee have continued to issue *Science in Parliament,* which summarizes important Parliamentary proceedings relating to science and technology.

The following officers have been appointed for 1943: *President,* Lord Samuel; *New Vice-presidents,* Captain L. F. Plugge, M.P.; Professor B. W. Holman, R. B. Pilcher (Institute of Chemistry); *Chairman,* E. W. Salt, M.P.; *Vice-chairman,* Professor J. A. Crowther (Institute of Physics); *Deputy Chairman,* M. P. Price, M.P.; *Honorary Treasurer,* C. S. Garland (Institution of Chemical Engineers); *Honorary Secretary,* Dr. W. R. Wooldridge (National Veterinary Medical Association).

THE PROPOSED GEOLOGICAL UNION

F. L. AUBIN, president of the American Association of Petroleum Geologists, has given out the following statement in regard to a plan for the organization of a geological union:

During the present emergency the geologists and especially such organizations as the Geological Society of America, the American Association of Petroleum Geologists, the Society of Exploration Geophysicists and others have attempted to bring to the attention of the proper military and other governmental agencies the fact that these scientific and technical men have special qualifications applicable not only to military operations, but also to other operations in civilian capacities having a direct relation to essential and vital phases of the war effort. The results of all these efforts have not been entirely successful or satisfactory.

In connection with a study of this subject, we have come to several conclusions, as follows:

(1) That our greatest handicap in securing results has been the ignorance or lack of public understanding of the science of geology and related subjects and especially their application to the important military, engineering and other operations and problems connected with both the war and the peace.

(2) That in order to create an understanding of geology by the public and others concerned, it will be necessary to educate the interested public and to popularize our scientific and technical accomplishments through some medium other than those now established. If such a medium is organized and the policy carried out along the proper lines, it would be of valuable assistance in supporting the present and future efforts of the geological societies during the present emergency and also future post-war conditions and adjustments.

(3) That the proposed plan of Carey Croneis as outlined in his address, "Geology in War and Peace," before the Denver meeting of the American Association of Petroleum Geologists, later published in the July, 1942, *Bulletin,* and still later amplified in his address on "Geological Warfare" before the affiliated geological societies of the American Association of Petroleum Geologists, is sound, reasonable, and will fulfil the requirements of the project under consideration. In brief, Dr. Croneis proposes to form an outside organization such as an "American Geological Association" or "Geological Union" to carry out the above program. Many of the members of your society or organization are familiar with the views of Dr. Croneis, and in the event you would care to investigate the pro-

[1] From *Nature.*

posal further, it is suggested that you read the above-mentioned address. Practically all officers and members of the American Association of Petroleum Geologists and affiliated societies are extremely interested in this project.

The American Association of Petroleum Geologists will hold its annual meeting in conjunction with the Society of Economic Paleontologists and Mineralogists and the Society of Exploration Geophysicists in Fort Worth, Texas, on April 7, 8 and 9.

With this in mind, the executive committee of the American Association of Petroleum Geologists proposes to hold a meeting from 9: 00 A.M. to noon, or later, if necessary, on April 10, following the conclusion of the meeting, to discuss, plan and organize the American Geological Association (or similar title). You are, therefore, invited and urged to appoint representatives to attend this meeting so that they can give you a report on the proceedings. Even though you may not feel like delegating authority to these representatives to act in behalf of your society, you are still urged to have them present and take part in the discussion and plans.

We hope that you are in accord with our views on this matter and that we will receive your hearty cooperation. Please advise the names of your representatives, if you wish to participate in this project.

THE NATIONAL CONFERENCE ON PLANNING FOR WAR AND POST-WAR MEDICAL SERVICES

THE National Conference on Planning for War and Post-war Medical Services held on March 15 a joint meeting at the Waldorf-Astoria Hotel under the auspices of the Carlos Finlay Institute of the Americas. The medical societies participating were the American Medical Association, the American College of Physicians, the American College of Surgeons, the American Drug Manufacturers Association, the American Hospital Association, the American Pharmaceutical Manufacturers Association, the American Pharmaceutical Association, the American Surgical Trade Association, the Wholesale Surgical Trade Association and the National Physicians Committee for the Extension of Medical Services.

The conference was devoted to a discussion of the spread of disease as a consequence of the war, including malaria, influenza and tropical diseases. It was emphasized that malnutrition in many lands will increase further the danger of the spread of epidemic and other diseases.

The speakers at the morning session included Lieutenant Colonel Thomas T. Mackie, Army Medical School, Washington, D. C.; Professor Thomas Francis, Jr., and Dr. Lowell T. Coggeshall, both of the School of Public Health of the University of Michigan; Dr. John B. Youmans, of the School of Medicine of Vanderbilt University. Dr. James E. Paullin, president of the American College of Physicians and president-elect of the American Medical Association, presided.

In the afternoon addresses were made by Dr. Edward C. Elliott, president of Purdue University and member of the War Manpower Commission; Colonel C. F. Shook, Army Medical Corps, and Dr. A. R. Dochez, Columbia University. Brigadier General Fred Rankin, Army Medical Corps, president of the American Medical Association, presided.

Speakers at the evening dinner-session were Nelson A. Rockefeller, coordinator of Inter-American Affairs, Washington, D. C.; Frederick P. Keppel, of New York; Norman Davis, chairman of the American Red Cross, and Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association. Basil O'Connor, president of the Carlos Finlay Institute and of the National Foundation for Infantile Paralysis, was toastmaster.

CONFERENCE ON FISHERIES

THE National Research Council called a conference on February 15 and 16 of twenty-six representatives of the scientific, administrative and commercial aspects of the fishing industry, to discuss better utilization and conservation of resources of the sea and inland waters in the war effort. The conference passed the following resolution:

> A serious shortage exists in the production of food fish and fish meal (an important ingredient of certain farm animal feeds) and it is in the interest of the war effort that every means be taken to increase production, not only in the United States but also in Canada, Newfoundland and Mexico, whence the United States has formerly drawn a portion of its supplies.
>
> The conference, in examining the question, is of the opinion that the state of affairs warrants immediate study, consideration and appropriate action by the Government of the United States, and it suggests that the sympathetic cooperation of the Governments of Canada, Newfoundland and Mexico be enlisted in the task of increasing the fisheries production of North American waters.
>
> The conference is further of the opinion that the only way to obtain large increase in production is to provide fishing vessels, gear, crews and processing plants for increased exploitation of the great oceanic fisheries.
>
> Lesser sources of fisheries products should also be developed and utilized to the fullest possible extent.
>
> Increased exploitation should not be applied to species that have been demonstrably over-fished.

Evidence was presented at the conference indicating that the great oceanic fisheries, herring (including pilchard), cod and haddock, could be more heavily exploited without danger of over-fishing.

WAR CONFERENCE ON INDUSTRIAL HEALTH

THE medical, surgical and industrial hygiene experts who are safeguarding the well-being of more than twenty million industrial workers have agreed to pool their knowledge and exchange their experiences regarding the many new and complex problems of wartime production. For this purpose their organizations—The American Association of Industrial Physicians and Surgeons; the American Industrial Hygiene Association, and the National Conference of Governmental Hygienists—are combining their annual meetings in a four-day "War Conference" at Rochester, N. Y., to be held from May 24 to 27. Among the problems to be discussed from a practical standpoint are:

The mass entry of women into industry;

Older-age employees, with their various associated problems; proper placement and employability considerations of the 4F rejectees;

Rehabilitation and proper employment of those already discharged from the military services because of disabling conditions;

Toxic and other hazards from new substances, new processes and the use of substitute materials;

Absenteeism; fatigue; nutrition;

Effects of long hours; double shifts; two-job workers; overtime; increased industrial accident rates;

Advances in the treatment of illnesses and injuries, and many others.

This joint meeting will be a report on the state of the nation by the men who know in matters of industrial health. Dr. William A. Sawyer, medical director of the Eastman Kodak Company, is general chairman; Dr. James H. Sterner and Lieutenant Commander J. J. Bloomfield are arranging the programs.

Physicians and surgeons, hygienists, engineers, nurses, executives—all who are interested in the problems of industrial health and their solution—are invited to attend as many of the sessions as they can arrange for; no registration fee is required.

SCIENTIFIC NOTES AND NEWS

DR. ISAIAH BOWMAN, president of the Johns Hopkins University, previously director of the American Geographical Society, has been elected president of the American Association for the Advancement of Science to succeed Dr. Arthur H. Compton, of the University of Chicago. Due to the postponement of the New York meeting Dr. Bowman was elected by mail ballot.

DR. SIMON FLEXNER, emeritus director of the Rockefeller Institute for Medical Research, of which he was director from 1920 to 1935, reached his eightieth birthday on March 25.

THE Borden Company Prize of $1,000 for research in the chemistry of milk has been awarded by the American Chemical Society to Dr. Earle O. Whittier, senior chemist of the Bureau of Dairy Industry, U. S. Department of Agriculture. The prize, which will be formally presented on April 14 at a general session of the meeting of the society in Detroit, is given in recognition of researches in the chemistry of milk constituents. These studies have been concerned chiefly with the utilization of lactose and casein, the chemistry of the manufacture and uses of lactic acid, acid-base equilibria and the buffer values of milk and milk constituents, oxidation-reduction equilibria in milk and ionic equilibria which are fundamental to a knowledge of the stability of the protein systems.

THE University of California at Los Angeles during the observance of Charter Week conferred the honorary doctorate of laws on Dr. George David Birkhoff, Perkins professor of mathematics and dean of the faculty of arts and sciences of Harvard University.

WILLIAM LOREN BATT, vice-chairman of the War Production Board and president of the SKF Industries, was presented on March 17 with the annual Philadelphia award "as the citizen who performed the most distinguished service for the city in 1942." The award carries with it the sum of $10,000.

DR. RUDOLPH MATAS has been presented with the medal of the Nu Sigma Nu Degree of Merit. This award is in recognition of approximately thirty years service rendered by Dr. Matas to the fraternity as a faculty member. Former recipients of the medal are Victor C. Vaughan, Nicholas Senn, J. P. McMurrich, W. H. Welch, F. G. Novy, G. C. Huber, W. H. Park, J. M. T. Finney, T. H. Sollmann and James Bryan Herrick.

BY action of the executive committee of the American Association of Anatomists, Professor Eliot R. Clark, of the University of Pennsylvania, has been appointed acting secretary-treasurer of the association, in the place of Professor Francis H. Swett, deceased, to serve until the next meeting at which an election may be held. While the regular meeting of the association, scheduled for Montreal, has been cancelled, two sectional meetings have been organized: one in Chicago at the University of Illinois College of Medicine on April 23 and 24, of which G. von Bonin is *secretary,* and a second in Philadelphia at

the Wistar Institute of Anatomy and Biology, on April 22 and 23, with E. J. Farris as *secretary*.

THE resignation is announced of Dr. William F. Petersen from the professorship of pathology at the College of Medicine of the University of Illinois. He plans to devote his time to research on the weather and its effect on human beings.

DR. ARNOLD LOWMAN, research chemist and specialist in the fields of food analysis, vitamin assays and pharmaceutical manufacturing, has been appointed lecturer in pharmacology at the Medical School at San Francisco of the University of California.

DR. GERTRUDE RAND has been appointed research associate in ophthalmology on the Knapp Foundation, College of Physicians and Surgeons, Columbia University.

DR. LOUISE STANLEY, chief of the former Bureau of Home Economics, has been appointed special assistant to Dr. Eugene C. Auchter, research administrator, U. S. Department of Agriculture.

DR. GERARD A. ROHLICH, assistant professor of sanitary engineering at the Pennsylvania State College, has become senior civil engineer (sanitary) in charge of the special problems group of the water and sewage unit of the Repairs and Utilities Branch, Office of the Chief of Engineers, War Department, Washington, D. C.

DR. CARLOS U. CESCO and Dr. Jorge Sahade, of the Astronomical Observatory at La Plata, Argentina, have been appointed volunteer research assistants at the McDonald and Yerkes Observatories and will arrive in the United States in the latter part of the summer. They are being sent by their government to investigate methods in astronomy and astrophysics now in use at the Yerkes and McDonald Observatories.

IN deference to a request from the Lord President of the council to the British War Office, Sir Charles Darwin, scientific adviser to the Army Council, returned on March 1 to his work as director of the National Physical Laboratory. He is succeeded as scientific adviser by Professor C. D. Ellis, Wheatstone professor of physics, King's College, London, who has been serving as deputy scientific adviser.

DR. M. J. BLISH, since 1939 chief of the Protein Division of the Western Regional Research Laboratory, U. S. Department of Agriculture, Albany, Calif., has become chief of the Research Laboratory of the Amino Products Company, a Division of International Minerals and Chemical Corporation. He is stationed at the Amino plant at Rossford, Ohio, and is working under the direction of Dr. Paul D. V. Manning. Ralph W. Shafor, for the past thirteen years manager of the beet sugar division of the Petree and Dorr Company, New York City, also has joined the staff of the corporation.

DR. WILLARD M. HOEHN has been promoted to the position of assistant director of the laboratories George A. Breon and Company, Kansas City, Mo. He is in charge of the research program on sterol compounds.

WILLIAM J. PRIESTLY, chief of the alloy-steel branch of the War Production Board, has resigned to return to the position of vice-president in charge of research and development of the Electro-Metallurgical Company, New York. He is succeeded by Louis E. Creighton, of Detroit, who for the present will continue to serve also as chief of the aircraft alloy steel section.

DR. CHARLES M. SLACK, of the Westinghouse Electric and Manufacturing Company, has been appointed assistant research director of the lamp division at Bloomfield, N. J.

PROFESSOR ALLYN C. SWINNERTON, for twenty-one years head of the department of geology at Antioch College, has leave of absence to undertake work in Washington, D. C., as consultant to the Research and Development Division of the Signal Corps.

DR. JULIAN A. STEYERMARK, assistant curator of the herbarium at Field Museum of Natural History, has leave of absence for the duration of the war to enable him to accept an appointment from the Board of Economic Warfare of the United States Government to work in Central and South America on the cinchona project. He has left Chicago to fly to Guatemala City, which will be his first headquarters.

A TOUR is being made of American meteorological stations and weather bureaus by meteorologists of the USSR. The party includes Captain Constantin C. Speranski, of the Soviet Navy, assistant director of the Soviet Hydrometeorological Service, Moscow; Major Mark I. Lvovitch, army hydrologist at the Soviet Hydrological Institute at Sverdlovsk, and Lieutenant Colonel Serapion Pagava, army chief of the Long Range Forecasting Division of the Central Meteorological Institute, Moscow. The party is accompanied by interpreters and by U. S. Army officials.

DR. DUNCAN A. MACINNES, member of the Rockefeller Institute for Medical Research, is giving from March 22 to 26 the annual series of Priestley lectures at the Pennsylvania State College. The series, sponsored by Phi Lambda Upsilon, is now in its seventeenth year, having been initiated in 1926 by Dr. Wheeler P. Davey, research professor of chemistry and physics.

DR. W. H. SEBRELL, surgeon of the Public Health Service of the National Institute of Health at Bethesda, Md., gave an address entitled "Nutrition in a Changing World" at the opening session of a conference on "Nutrition in War Time," held at the Medical College of Virginia on March 25, 26 and 27.

DR. W. F. G. SWANN, director of the Bartol Research Foundation at Swarthmore, Pa., lectured on the evening of March 18 before the Lancaster, Pa., Branch of the American Association for the Advancement of Science. The lecture was entitled "Science in This Confused Age."

PROFESSOR LAURENCE H. SNYDER, chairman of the department of zoology of the Ohio State University and chairman of the Committee on Human Inheritance of the National Research Council, gave lectures on February 9 and 10 at Louisiana State University. The main address, "Heredity and Modern Life," was sponsored jointly by the department of zoology and the university chapter of the Society of Sigma Xi. The second lecture was presented before the seminar in zoology. It was entitled "The Mutant Gene in Man." Dr. and Mrs. Snyder were guests of honor at a tea given by the department on February 9, and on the following day at a dinner at the Faculty Club.

PLANS have been made to hold the thirty-fourth annual meeting of the American Oil Chemists Society in New Orleans from May 12 to May 14. The Roosevelt Hotel has been selected for headquarters, and all technical sessions, committee meetings and a dinner-dance will be held there. The local committee, headed by Dr. K. S. Markley, of the Southern Regional Research Laboratory, New Orleans, is arranging a program that will include the chemical, analytical, technological, industrial and economic phases of the production and utilization of fats and oils. All who plan to attend should make hotel reservations as early as possible.

CHANGES in the staff of editors of *Biological Abstracts* within the last few months include: Dr. Gustav Swanson, University of Minnesota, editor of "Wildlife Management—Terrestrial," replacing Dr. W. L. McAtee, who has resigned; Dr. Francis O. Schmitt, Massachusetts Institute of Technology, editor of the section "Biochemistry-Biophysics"; Dr. W. G. Andberg, University of Minnesota, succeeding Dr. C. E. Blye, acting editor of the section, "Veterinary Science"; Dr. F. E. J. Fry, University of Toronto, editor of the section "Cyclostomata, Elasmobranchii and Pisces," beginning with the April, 1943, issue; Dr. J. H. Black, 1405 Medical Arts Building, Dallas, Texas, editor of the "Allergy" section, beginning with the June–July issue. Dr. August E. Miller, Dayton, Ohio, has resigned as the editor of the Acarina section.

ACCORDING to *Nature* sound films of honorary members and Faraday medallists of the British Institution of Electrical Engineers are being shown before the institution as follows: March 4: Sir J. J. Thomson and Lord Rutherford; April 1: Sir Ambrose Fleming and Dr. A. E. Kennelly; April 29: Lord Hirst and Dr. F. B. Jewett.

FIRE completely destroyed the one-story frame anatomy building of the University of Kansas at Lawrence, on the evening of March 3. A part of the equipment of the department was saved. The fire started in the southwest part of the building and fanned by a strong wind the contents of the office in that part of the building were completely destroyed. All the charts, models and demonstration material for gross anatomy were lost, but the metal dissecting tables and the cadavers were saved. Most of the slides and charts for the class in microscopic anatomy were saved. Glasswork is being continued temporarily in Snow Hall, the biology building.

GIFTS amounting to $201,921 have been made to New York University during the past three months. They include $100,000 from the George F. Baker Charity Trust, half of which will be used to increase the endowment of the Samuel A. Brown professorship of therapeutics and the remainder for the College of Medicine, at the discretion of Dean Currier McEwen. The Commonwealth Fund gave $9,784 to the College of Medicine for the study of hypertensive and renal diseases, research in obstetrics and gynecology and other uses, and the National Conservation Bureau gave $9,000 to the Center for Safety Education in the Division of General Education. The National Foundation for Infantile Paralysis contributed $7,500 toward the recently established training program for physiotherapists which was opened by Sister Elizabeth Kenny in the School of Education. A gift of $7,500 was made by the Rockefeller Foundation for various research projects in medicine and applied mathematics. Alumni and friends of the College of Medicine, through Dean McEwen, gave $6,794 to the emergency fund, and the Alfred P. Sloan Foundation, Inc., gave $5,277 to the Educational Film Institute and the Recordings Division of the Film Library. The sum of $2,850 was received from the Josiah Macy, Jr. Foundation for the Vitamin "B" Filtrate Factor Fund, and $1,800 from the John and Mary R. Markle Foundation for the Endamoeba Histolytica Research Foundation for study of the disease under the direction of Professor Robert Chambers.

DISCUSSION

THE COURTING FLIGHTS OF TABANIDS

MOST species of insects are represented by both males and females, and normally mating occurs the same as in the higher animals. The males may use any one of several approaches to the act of copulation. Some use the primitive cave man method of manhandling the female without preliminary courtship. Others may stimulate the mating desire in the female by furnishing glandular secretions, probably containing sex hormones, which she eats. Still others lull the female into submission by offering her titbits, with odors, bright colors or with monotonous hypnotic music. The males of the common horseflies or tabanids, seemingly, resort to the use of the musical hum of their wings and their peculiar dizzy courting or hovering flights for attracting the females. Few workers in this country have observed and described these courting flights and the mating of tabanids. Mosier and Snyder[1] observed the early morning courting flights of *Tabanus americanus* in the Florida Everglades in 1917 and 1918. J. S. Hines,[2] in Ohio, observed *Tabanus sulcifrons* in the act of mating between 8 and 9 o'clock in the morning during mid-August. However, he apparently did not observe the courting flights which occur earlier just at daybreak.

During the past summer and early fall, the writer made rather extensive observations on the courting flights of the males of the two species of tabanids, *T. sulcifrons*[3] and *T. giganteus*[3] at Columbia, Missouri. The first species is the medium-sized, brown horsefly so common during the summer and early fall in Missouri. It was first heard and seen hovering in great numbers above elm, walnut and hickory trees in the writer's lawn at 5:30 in the morning of July 27, though it probably began these courting flights prior to that date. Its hum resembled that of drone honeybees or large blowflies, and its flights observed in previous summers were mistaken for those of blowflies. These flights continued until September 2. The flights always began just at daybreak when the light intensity was still only a fraction of one foot-candle and they continued for 20 to 25 minutes and ceased by the time the light intensity reached three to five foot-candles. At no time did the flies hover nearer the ground than 30 feet. Most of them continued to hover at tree-top level, except as they began to disperse, when they would often rise and hover high above the trees for a few minutes. The courting flights included only the males, though the females were always on wing about the lawn and low shrubs. Two males in the act of hovering were taken with a net from the roof of the house. As the summer advanced and the days grew shorter, the flights began later so that by September 1 they did not begin until a few minutes after 6 o'clock. The courting flights of this fly did not occur when the temperature was below 60° F. and they seemed to be confined to scattered rather restricted areas. A number of others here around Columbia reported seeing them during the summer. Just why the males of this species perform these 20-minute courting flights at daybreak when, according to Hines' observations, mating occurs at 8 o'clock in the morning, or the equivalent of 9 o'clock central war time, is difficult to understand. On the other hand, cocks do much of their crowing at this same twilight period. During the courting flight period, females were found to have well-developed eggs, but in no case was copulation observed.

In the fall, as this brown species became less abundant, the larger, dark species, *T. giganteus,* became more abundant. On September 9, several males of this species were seen hovering three to five feet above the writer's lawn and driveway not at daybreak but just at dusk. The courting flights of this species continued for only about a week and the last males were observed on September 15. Three specimens taken with a net on September 9 were males with fully developed testes, and during the courting flight period females were taken repeatedly, but in no case was mating observed. For their courting flights, this species seemed to require more light, as they began soon after 7 o'clock in the evening with a light intensity of about 30 foot-candles and continued for some thirty minutes, ceasing when the light had dropped to an average of about 3 foot-candles. This species would often hover, seemingly without fear, only a few feet from the observer, which made it possible to note their fully distended body, alertness to moving objects, and their tendency to reverse their direction after hovering almost motionless in one spot for several seconds. The pitch of the hum of this species was considerably lower than that of the smaller brown species.

That these peculiar hovering flights of male horseflies have some connection with mating seems certain,

[1] Mosier and Snyder, *Proc. Ent. Soc. Wash.*, 20, 115, 1918.

[2] J. S. Hines, *USDA Bur. Ent. Tech. Ser.*, No. 12, Part III, p. 24, 1906.

[3] Determinations made by Dr. Alan Stone, USDA Bur. Ent. and Plant Quarantine.

but these observations throw little light on just what that connection really is.

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MALARIAL CRYPTOZOITES

THE recent attention which has been directed at the initial stages in the early schizogonic or asexual cycles of malarial parasites has revealed an inadequacy in terminology which it seems desirable now to correct. The stage which initiates this cycle is, of course, the sporozoite which is the end product of the sporogonous cycle in the mosquito. If the theory of Schaudinn were correct that sporozoites enter directly into erythrocytes and transform into trophozoites and schizonts the present terminology would be adequate. However, there is both direct and indirect evidence that this direct entry does not occur, but that development occurs elsewhere in the body before the erythrocytes are invaded. There is the choice of expanding our conceptions of the terms, trophozoite and schizont, to include any such stages in the life-cycle or of proposing a new term for the stages in question. We believe that the latter course is preferable, since the terms, trophozoite and schizont, have become so definitely associated with stages of the malarial parasites which live in erythrocytes.

For the first generation, exoerythrocytic stages of the parasite which develop from sporozoites we propose the name "cryptozoite." This term is chosen because (1) historically these stages remained hidden for a long time and (2) they are even now difficult to demonstrate. The zoological term "cryptozoic," referring to animals which inhabit dark, hidden places is already in use. We suggest that in the use of the new word care should be taken not to apply it specifically to any particular type of parasite falling within the above definition. Different types of cryptozoites might be described as uninucleate cryptozoites, multinucleate cryptozoites, cryptozoic schizonts, etc. Since, by definition, a cryptozoite is an exoerythrocytic stage of the parasite it should be emphasized that the converse is not necessarily true. In fact, it is definitely known that some exoerythrocytic stages arise from erythrocytic parasites. If further investigation should reveal that in some species of malarial parasites there is direct entry of the sporozoite into the erythrocyte it would suffice in describing the schizogonous cycle of such species to indicate that they lacked any cryptozoic stages. Moreover, if the cryptozoites of various species should prove to fall into various types, the procedure followed by Porter[1] in reference to exoerythrocytic stages might be adopted. He indicated that there are at least two types of exoerythrocytic stages, *elongatum*-type and *gallinaceum*-type, according to whether they resembled the predominating exoerythrocytic stages of these two species of *Plasmodium*. We realize that research will need to be done on each species of malarial parasite to determine in each case the length of life, the synchronism, the tissue affinities and the fate of cryptozoites.

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[1] R. J. Porter, *Jour. Inf. Dis.*, 71: 14, 1942.

THE NEPHELINIZED PARAGNEISSES OF THE BANCROFT REGION, ONTARIO

A TOTAL of more than seven months was spent in the field in the Bancroft-Haliburton region of Ontario in 1941. A detailed geological and topographical map was prepared of the important area of nepheline-bearing rock to the immediate east of Bancroft village; the map is somewhat different from all previous maps of that area. Other areas were examined in varying detail. A great deal of thin section examination was carried out, and many analyses were made.

All the evidence gathered points to a parasedimentary origin for the nepheline-bearing rocks. They are interbanded conformably with a series of Grenville-type micaceous paragneisses and crystalline carbonate rocks. Delineation of the belt of rocks to the east of Bancroft indicates a fold, probably a syncline plunging east, and crossfolded north and south. The central and outer bands, enclosing the nepheline-rich gneisses, are composed dominantly of nepheline-poor and nepheline-free gneisses of great variety. Gradations in nepheline content both along and across the strike were noted. There is crystalline limestone of several degrees of purity around the limbs of the fold, and a good deal of it is to be classed as "flow marble."[1]

Several points indicate that the nepheline came into existence through a process analogous to granitization, differing only in the chemistry of the reactions. Osborne[2] believed that some nepheline rocks were replacements. Also, it is believed that the nephelinization is post-folding, since the flow marble contains fragments of all rocks except those containing nepheline,[1] and the zones richest in nepheline are in the shape of drag folds along the limbs of the major structure which suggest that structural openings localized intense nephelinization.

No evidence of the existence of a nepheline syenite magma was noted except in the case of certain of the nepheline pegmatites, many of which appear to be the result of regeneration of the nepheline of the paragneisses, and others of which may have been sec-

[1] F. Chayes, *Bull. Geol. Soc. Amer.*, LIII, 1942.
[2] F. F. Osborne, *Amer. Jour. Sci.*, XX, 1933.

ondary magmas, perhaps fluxed by CO_2 released by reactions of granitic or syenitic juices on limestone. Most of the nepheline pegmatites appear to be replacements to more or less degree.

The visible granite is definitely post-nepheline in age, but apparently has caused a large amount of albitization. Quartz-bearing dike rocks cut the nepheline rocks.

The authors contend that the limestone-syntexis theory is at fault mainly in mechanics; however, the chemical reactions embodied may apply under the present theory. The exact composition of the sediments prior to nephelinization is not understood, but they appear to have been impure limey rocks. Calcite is present in all the rocks examined and is perhaps least in those richest in nepheline. The solutions causing the alteration may have been normal granitic or syenitic liquors rich in Na_2SiO_3, and probably contained Al_2O_3 and Fe_2O_3. The source of the solutions is also indeterminate; they may have come from an earlier unexposed granitic or syenitic body, or may have been related to the visible intrusions that manifested themselves at first merely by exhalations, and later by actual near-surface intrusion and caused the albitization of the rocks formed by their first action.

Comparison is made of the Bancroft area with other areas in the major belt of alkaline rocks and serves only to strengthen the thesis of origin.

W. K. GUMMER[3]
S. V. BURR[4]

SCIENTIFIC BOOKS

PETROLEUM REFINING

Chemical Refining of Petroleum. By VLADIMER A. KALICHEVSKY and BERT ALLEN STAGNER. Revised edition. 550 pp. New York: Reinhold Publishing Corporation. 1942. $7.50.

THIS is a thorough revision of the authors' valuable text and reference book, the first edition of which appeared in 1933. In the revised edition the text material has been expanded from 352 to 416 pages, the supplementary list of U. S. patents on petroleum refining occupies 79 pages and includes only patents not discussed in the text and not listed in the first edition, in which the list of patents on the subject covered only 25 pages and included foreign patents. In the revision no material change has been made in the conversion and other tables given in the first edition, but a 12-page glossary of terms has been omitted from the revised edition. The indices include an index of patent numbers and an author's index, as well as the subject index which covers both the text and the supplementary list of patents.

While there have been only a few changes in the general arrangement of the text, it has been almost completely rewritten and much new material introduced. Chapter I, on the composition of petroleum, discusses the classes of compounds and the principal products. A brief section on analysis of petroleum hydrocarbons mentions the use of new chemico-physical methods and refers to recent researches which fix the composition in terms of the characteristic radicals rather than by attempting to isolate individual compounds. This is followed by a long chapter (75 pages) on treatment with sulfuric acid, containing new material on polymerization of unsaturated compounds, cold acid treatment of cracked naphthas, low temperature treatment and octane rating, and distillation after treatment. Other sections of this Chapter II have been rewritten and somewhat enlarged. At the end is a bibliography of 265 references on acid treatment. These bibliographies at the end of each chapter constitute a favorable feature of the book.

Chapter III discusses acid sludge and its disposal, recovery and concentration of sulfuric acid; and contains a new section on removal of hydrogen sulfide from cracked gases and its use in manufacture of sulfuric acid. In Chapter IV, on treatment with alkaline reagents, new material, particularly on the extraction of mercaptans, has been introduced. Both of these chapters have been largely rewritten.

Chapter V covers sweetening operations and elimination of elemental sulfur, which made up Chapter IV of the first edition, as well as the reduction of total sulfur in light distillates, which was the subject-matter of Chapter VII in the previous edition. As an introduction to these subjects the laboratory analysis of oils for various sulfur compounds, and tests for corrosiveness in oil are discussed in some detail. In the discussion of sweetening operations the oxidation of mercaptans by elemental sulfur, by oxygen or air, and by alkali hypochlorite is followed by new material on the extraction of mercaptans. The sodium plumbite ("doctor solution") treatment has been well elucidated; consideration of recent researches on the subject and of sweetening before acid treatment or before distillation is included. Sweetening by means of lead sulfide, other sulfides, copper salts and hypochlorite have shown little development and the text therefore follows largely the material given in the first edition. New sections on extraction of mercaptans by increasing the solvent power of caustic alkali solutions and

[3] Geologist and petrographer, Aluminum Company of Canada, Ltd., Arvida, Quebec.

[4] Geologist, Aluminum Company of Canada, Ltd., Arvida, Quebec.

by treatment with alcoholic solutions of alkalies and alkali metals include discussions of the solutizer and methanol extraction processes and reflect new developments in this field. In the section on reduction of total sulfur in light distillates, new material consists of the catalytic desulfurization (Houdry) process and the perco process. Other processes are briefly given and it is stated: "as yet the only method that has come into extensive use for desulfurizing gasoline, straight-run or cracked, is that of strong sulfuric acid under carefully controlled conditions, as described in Chapter II."

Chapter VI expounds refining by absorption; it has been largely rearranged and much improved. The following divisions have been rearranged and enlarged: Classification, methods of preparation, chemical and physical properties and methods of testing absorbents; refining by percolation, contact filtration and regeneration of absorbents. Contact decolorization and refining of both light and heavy oils has been clarified by rearrangement; vapor phase refining with absorbents has been much enlarged and classified under the Gray process and the Houdry catalytic process. New material in this chapter includes: A section on color of petroleum oils with discussion of methods and references on relations between color scales; table showing effect on color of temperature and time of contact with different clays; and a new section on filtrol fractionation.

Chapter VII, in spite of the rapid development in refining by solvents, is shorter than the corresponding chapter in the first edition. This exception is well justified, the explanation being the appearance in the meantime of an excellent book ("Modern Methods of Refining Lubricating Oils," by V. A. Kalichevsky, New York, 1938, Reinhold Publishing Co.), which is devoted mainly to solvent refining and to which reference is made for details of the subject. This enables the authors to make a summary of the subject in Chapter VII, and as such it is the best which has come to the reviewer's attention.

Completing the second edition are four short chapters on detonation and antidetonants; inhibitors of atmospheric oxidation of petroleum products, antioxygens; gums in cracked petroleum products; and finally deterioration of lubricating and similar oils, addition agents. These are well written, authoritative and bring the treatment of the subjects up-to-date.

JEROME J. MORGAN

ORGANIC CHEMISTRY

Organic Chemistry. An Advanced Treatise. By HENRY GILMAN, editor-in-chief. Editorial board: Roger Adams, Homer Adkins, Hans T. Clarke, Carl S. Marvel and Frank C. Whitmore. Second edition. Vol. I, pp. 1–1077; Vol. II, pp. 1079–1983. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Limited. 1943. $6\frac{1}{4} \times 9\frac{1}{4}$ in. Bound in green buckram. $7.50 per vol.

FEW recent treatises on chemistry by American authors have received, both here and in other countries, such a universal and enthusiastic welcome and commendation as the first edition of this work. From the date of its publication in 1938, it has been regarded as an outstanding and authoritative contribution to the literature of its subject. This new edition, therefore, which brings many of the chapters in the previous one up to date, and introduces some new ones, is assured of a most cordial reception by all organic chemists.

Chapters in the older edition which do not appear in the new one are: Open-chain nitrogen compounds; The chemistry of pyrimidines, purines and nucleic acids; Carotenoids: The polyene pigments of plants and animals; and Rotatory dispersion. On the other hand, the edition under review contains the following new chapters: The reactions of aliphatic hydrocarbons (Egloff), Synthetic polymers (Marvel and Horning), Catalytic hydrogenation and hydrogenolysis (Adkins and Shriner), Organic sulfur compounds (Connor), Aliphatic fluorides (Henne), The chemistry of the porphyrins (Corwin), Chlorophyll (Steele) and The redistribution reaction (Calingaert).

In addition to members of the editorial board, twenty-five other distinguished chemists make up the list of contributors. The books are indispensable to the organic chemist who wishes to keep in the forefront of his profession.

In purpose, plan, scope and format, the new edition resembles the old, except that the color of the binding is green instead of maroon. The work of the printers and publishers is excellent in every respect.

MARSTON TAYLOR BOGERT

CARDIOLOGY

A Short History of Cardiology. By JAMES B. HERRICK, M.D., emeritus professor of medicine, Rush Medical College, consulting physician to Presbyterian Hospital, Chicago. 258 pp. Springfield, Ill., and Baltimore, Md.: Charles C Thomas. 1942.

IT is appropriate that Dr. James B. Herrick, the dean of American cardiologists, should have chosen to record a history of his beloved subject. The ever-increasing publication of articles and books in America dealing with the history of medicine is eloquent testimony that the culture of American medicine is reaching its adult stage.

This short history of cardiology is well written and its interesting narrative style and logical sequences maintain the reader's constant attention and interest.

No noteworthy contributors among the ancients and semi-moderns have been omitted. Herrick, very appropriately, deals only briefly with the ancient physicians, for the real dawn of scientific cardiology coincides with Harvey's monumental dissertation, "De Motu Cordis" in 1628. Prior to this publication knowledge regarding the anatomy and the physiology of the heart and circulation was erroneous and fantastic and constructive advances in knowledge and understanding were only possible after correct, although unfinished concepts were clearly formulated.

The evolution of the science of cardiology up to the present time, although yet incomplete, is accurately portrayed. The correct basic premise of the anatomy of the heart and circulation inevitably led to physiologic understanding, the development of cardiovascular pathology, clinical cardiology and finally the more modern adjuncts such as roentgenography and electrocardiography.

Herrick, an outstanding clinician, has been remarkably able to present this brief but comprehensive work in a manner having particular appeal and interest to the internist. This is a book which merits the attention not only of the cardiologist, but all physicians and medical students.

F. A. WILLIUS

SPECIAL ARTICLES

A VIRUS RECOVERED FROM PATIENTS WITH PRIMARY ATYPICAL PNEUMONIA[1, 2, 3]

PRIMARY atypical pneumonia appears to be a clinical syndrome, but is probably not a single disease entity. The psittacosis group of viruses[4, 5, 6] *Rickettsia diaporica*,[7] and a virus infectious for the mongoose[8] each have been found to be etiologically related to certain groups of cases. That still other agents[9, 10, 11] may be associated with the syndrome has been suggested.

In this study specimens from patients were inoculated in different animal species by numerous routes and serial passages were carried out. In no instance were obvious signs of infection produced which could be reproduced in series. However, it was discovered that animals inoculated with certain specimens or with passage material from them developed antibodies capable of neutralizing a heterologous virus; the "pneumonia virus of mice"[12] hereinafter referred to as PVM. This observation suggested that there were in the agent recovered from current cases and in PVM minor common antigens.

Twelve strains of a virus have been recovered from 20 patients. Two were obtained from throat-washings, eight from sputa and two from plasma. All 12 possessed antigenic components also present in PVM. Although none produced obvious signs of infection on passage in available animals, nevertheless, immunological evidence indicated that the agent could be passed in series in both chick embryos and cotton rats. The virus was filterable through Berkefeld V candles, did not lose activity on storage at $-70°$ C for 6 months, withstood freezing and thawing 10 times, and was inactivated by heating at 56° C for 30 minutes.

Three filtered throat washings were inoculated in chick embryos and serial passages carried out. Rabbits injected with embryo material from one throat washing developed neutralizing antibodies against PVM, whereas rabbits injected with embryo material from the other throat washings did not.

Two specimens of plasma were tested, one intravenously in a rabbit, and one was inoculated in chick embryos with which rabbits were immunized. These rabbits produced neutralizing antibodies against PVM. As might be expected, PVM itself stimulated the production of neutralizing antibodies in rabbits more rapidly and in far higher titer than did the agent obtained from patients with primary atypical pneumonia.

Eighteen specimens of sputum and one throat washing were tested intranasally in cotton rats. Eight of the sputa and the throat washing stimulated the production in rats of neutralizing antibodies against PVM whereas the other 10 sputa did not. Of 32 normal cotton rat sera tested none contained antibodies against PVM. As was anticipated PVM itself

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[2] The Bureau of Medicine and Surgery does not necessarily undertake to endorse views or opinions which are expressed in this paper.

[3] The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and The Rockefeller Institute for Medical Research.

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stimulated the production of neutralizing antibodies in rats more quickly and in higher titer than did the human virus.

The human agent was passed in series either in cotton rat lungs or in chick embryos as well as on the chorio-allantoic membrane. Evidence for the presence of the agent in passage material was obtained by the demonstration of neutralizing antibodies against PVM in the sera of inoculated cotton rats. Histological sections of infected rat lungs and infected egg membranes stained by the Giemsa method, and impression films stained by the Macchiavello or Gram method failed to reveal the presence of elementary bodies, inclusion bodies, rickettsiae or bacteria.

The mongoose infectious virus[8] was restudied in the light of these findings. A suspension of infected mongoose lungs, stored at $-70°$ C for over $2\frac{1}{2}$ years, was available. Cotton rats were inoculated intranasally with this material and lung passages were carried out. None of the rats showed visible signs of infection and pulmonary consolidation was not produced. The suspension of infected mongoose lungs was also inoculated on the chorio-allantoic membrane and passages carried out. Cotton rats inoculated either with the lung or membrane passage material produced neutralizing antibodies against PVM indicating that the mongoose infectious virus possessed antigenic components also present in PVM and moreover that it could be passed in cotton rats as well as chick embryos.

Neutralization tests with patients' sera and the human agent were difficult to devise since the virus failed to produce signs of infection on passage in available animals. However, advantage was taken of the fact that a large supply of one sputum known to contain the agent was available and that this particular sputum on primary inoculation in cotton rats, though not on serial passage, produced definite pulmonary consolidation. Eaton and his coworkers[10] have reported that sputa from certain cases contained an infectious agent which produced pulmonary consolidation in cotton rats.

Of 32 cotton rats inoculated with this sputum pulmonary consolidation developed in 78 per cent. Furthermore, without exception, rats inoculated with this sputum produced neutralizing antibodies against PVM. When diluted to 1 per cent. with broth the sputum still caused consolidation in rats. Equal parts of a 20 per cent. suspension of the sputum and either undiluted acute phase or convalescent serum, previously inactivated from 11 patients, were mixed. Each mixture was tested in a group of 3 or 4 cotton rats. With the sputum-acute phase serum mixtures from 6 patients, 68 per cent. of 25 inoculated rats developed pulmonary consolidation, whereas with the sputum-convalescent serum mixtures from the same 6 patients, none of 25 inoculated rats developed pulmonary consolidation. With the sera obtained from 5 other patients mixtures of the sputum and either acute phase or convalescent sera failed in all of 32 rats to produce pulmonary consolidation. It seems noteworthy that all 11 convalescent sera completely neutralized the agent responsible for consolidation in cotton rats.

Convalescent human sera not only neutralized the agent responsible for pulmonary consolidation but also neutralized the agent responsible for the stimulation of antibodies against PVM in cotton rats. Moreover, rats inoculated with the human virus or with chick-embryo material infected with it produced antibodies which neutralized not only PVM but also the agent in the sputum responsible for consolidation in cotton rats. On the other hand, cotton rats inoculated with inactive material failed to develop neutralizing antibodies against either PVM or the human virus. This evidence suggests that pulmonary consolidation in the cotton rat and the development of antibodies against PVM were the result of infection by one and the same agent.

Acute phase and convalescent sera from these 11 patients were also tested against PVM itself. In no case was an increase in neutralizing antibodies against PVM demonstrable during convalescence. This observation may be explained on the basis that the antibody response of human beings to the antigenic components common to both the human virus and PVM may be too small to be measured by the technique employed. All the human sera were also tested against psittacosis virus, and with but one exception against lymphocytic choriomeningitis virus antigen as well, using the appropriate complement fixation procedures.[6, 13] All the human sera as well as all the immune rabbit sera and many of the immune cotton rat sera were also tested against influenza A and B viruses, using the RBC agglutination inhibition technique.[14] In no instance was a significant increase in antibodies against any of these four viruses demonstrable.

The available evidence suggests that the mongoose infectious virus, which appeared to be etiologically related to certain cases of primary atypical pneumonia studied in 1939, is related antigenically to the heterologous virus of mouse origin, the "pneumonia virus of mice." Since all twelve strains of the agent recovered from current cases of atypical pneumonia appear also to be antigenically related to PVM, it seems reasonable to think that they are either identical with the mongoose infectious virus or are very closely

[13] J. E. Smadel and M. J. Wall, *Jour. Exper. Med.*, 72: 389, 1940.

[14] G. K. Hirst, *Jour. Exper. Med.*, 75: 49, 1942.

related to it both in antigenic composition and biological characteristics.

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GONADECTOMY AND ADRENAL NEOPLASMS

CARCINOMA of the adrenal cortex is a relatively rare type of tumor in both man and in experimental animals. In man these neoplasms have been of unusual interest because of sexual disorders which have been associated with them. In experimental animals, carcinomas of the adrenal cortex have appeared too infrequently for critical study. Observations in this laboratory, however, indicate that primary carcinomas of the adrenal cortex can be produced in a high percentage of the individuals of at least one strain of mice by means of gonad removal.

It has been found that when mice of the extreme dilution strain (ce) were gonadectomized at two days of age, carcinoma of the adrenal cortex occurred in a high percentage of cases. Table 1 shows the frequency of these in various age groups up to one year. No such tumors have so far been observed in normal male and female mice of the ce strain. Adrenals of these mice are being studied in more detail, however.

Present knowledge indicates that sex hormones have an influence in the formation of certain types of neoplasms in mice. Increasing or decreasing these hormones is effective. It has been shown that injections of estrogenic hormones have been instrumental in

TABLE 1

Sex	Mice of ce strain Age at autopsy							
	4 months		6–7 months		8–10 months		11–12 months	
	No. of mice	Per cent with adrenal cancer	No. of mice	Per cent with adrenal cancer	No. of mice	Per cent with adrenal cancer	No. of mice	Per cent with adrenal cancer
Ovariectomized ♀♀ ...	4	0	9	88.9	3	100	6	100
Castrated ♂♂.	4	0	7	28.6	7	85.7	5	100

producing interstitial cell tumors of the testes,[1] carcinomas of the cervices,[2] adenomas of the hypophyses[3] and mammary gland carcinomas[4] in mice. In the dba strain of mice gonad removal resulted in nodular hyperplasia of the adrenal cortex and carcinomatous changes of the mammary gland in both sexes.[5, 6] It seems likely that all these results may be explained by the theory that hormonal imbalance is at least one of the factors leading to these forms of cancer. A more detailed study is to be reported elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

IMPROVED APPARATUS FOR LIVER PERFUSION

LIVER perfusion studies in which the R.Q. of the liver was found from the arterio-venous blood gas differences have resulted in extremely low R.Q.'s which have been interpreted as support for the theory that oxygen is being utilized by the liver in the formation of carbohydrate intermediates from fatty acid or fatty acid intermediates. The methods used in former studies did not control or measure the escape of CO_2 from the surface of the liver. It is conceivable that the amount of CO_2 passing from the liver into the surrounding air is considerable and would be related to the tension of the CO_2 in the perfusate and the production of CO_2 by the liver. If this loss of CO_2 from the liver could be measured exactly in terms of volumes per cent. of CO_2, the A.V. R.Q. could be corrected for the amount lost.

The escape of appreciable amounts of CO_2 is demonstrable by perfusing the liver in an air-tight tin box of known volume as shown in the accompanying diagram (Fig. 1). The box is washed out with warmed outside air at the start of the experiment. At the end of a given period of time the air in the box is sampled and analyzed for CO_2 and O_2. The CO_2 which enters the box from the surface of the liver is expressed in volumes per cent. from the total volume of perfusate passing through the liver during the period. The oxygen level in the box remains constant providing there are no leaks in the circulating system.

In Table 1 the average loss of CO_2 in volumes per

1 C. W. Hooker, W. U. Gardner and C. A. Pfeiffer, *Jour. Am. Med. Asn.*, 115: 443–445, 1940.
2 E. Allen and W. U. Gardner, *Cancer Research*, 1: 359–366, 1941.
3 W. Cramer and E. S. Horning, *Lancet*, 1: 247–249, 1936.
4 A. Lacassagne, *C. R. Acad. Sci.*, 195: 630, 1932.
5 Elizabeth Fekete, George Woolley and C. C. Little, *Jour. Exp. Med.*, 74: 1–8, 1941.
6 George Woolley, Elizabeth Fekete and C. C. Little, *Endocrinology*, 28: 341–343, 1941.

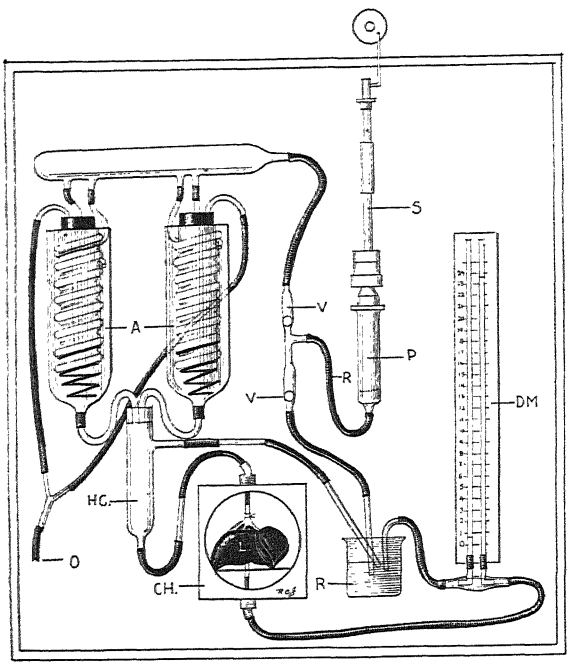

FIG. 1

cent. is 0.25 vol. per cent. This loss of CO_2 from the surface of the liver is sufficient to explain many of the R.Q.'s (arteriovenous) below the level found for the whole organism during starvation, reported in the literature (*e.g.*, Blixenkrone-Møller.[1]).

TABLE I

Arterial Vol. % CO_2	Venous Vol. % CO_2	Vol. % Diff.	A.V. R.Q.	Venous return cc/min gm of liver	ml CO_2 lost min gm of liver	Vol. % correction	Corrected R.Q.
11.01	11.56	0.55	.42	1.8	.0073	.26	.610
9.57	10.37	0.80	.73	1.8	.0055	.26	.965
7.71	9.87	1.87	.57	0.8	.0041	.48	.880
5.5	6.35	.85	.43	2.6	.0039	.19	.530
11.10	12.05	.95	.74	1.8	.0038	.21	.907
6.38	6.85	.47	.66	2.5	.0035	.13	.840

The apparatus shown (Fig. 1) is designed to eliminate several other sources of error as well in the perfusion technic, such as the loss of fluid by evaporation, wide fluctuation in CO_2 and O_2 levels of the perfusate, edema of the liver, turgence and discoloration caused by excessive hydrostatic pressure. Pressure can be kept constant and absolutely controlled within limits found for the portal vein of the cat. The volume of flow through the liver can be held constant and controlled.

The venous return can be estimated for a given period of time by means of the differential manometer (d.m.). A master curve is prepared by plotting the difference in height (h) between the two manometers when various volumes of perfusate are passing through the system (V) per minute. When V is plotted against $\sqrt{h}$ a linear relation is found between the values 80 cc/min and 250 cc/min for V. An extrapolation of this line intercepts the $\sqrt{h}$ axis at a distance (C) from zero. *K* is calculated in the formula $V = K\ (\sqrt{h} - C)$ and is constant between the above limits. Therefore, during an experimental run the differential reading (h) is taken at three levels of (V) venous return and *K* for this experiment is calculated. When *K* for a particular experiment differs from *K* for the master curve described above, h for the experiment is accordingly corrected and the venous return for any particular time can be estimated to within 1 per cent. error from the manometer reading by finding the V value on the straight line, *V* plotted against $\sqrt{h}$.

The sequence of flow through the apparatus shown below is as follows: blood passes from the reservoir (R) through the lower valve (V) to the pump (P), then through the upper valve (V) to the oxygenator (O) and to the hydrostatic column (H.C.), thence to the liver in the box (CH, closed by a friction lid) by way of the portal vein and leaves the liver by the hepatic vein passing the differential manometer (d.m.) and returns to the reservoir.

Oxygen bubbles through warm water and passes downward through the center of the spiral cylinder, then upward around the outside spirals. Perfusate passes down both the outside and inside spirals. There appears to be no loss of fluid by evaporation and the oxygen level in the perfusate remains reasonably constant in a given experiment, which in itself is indicative of a constant volume. The perfusate always to be preferred is one which most closely approaches the O_2 and CO_2-carrying capacity of whole blood and to which a compatible anticoagulant is added.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES AT TURRIALBA

RUBBER, cinchona, tropical fruits and many other crops of importance to America in both war and peace are expected to benefit by research at the new Inter-American Institute of Agricultural Sciences at Turrialba, Costa Rica, which it was planned to dedicate on the occasion of Vice-president Henry A. Wallace's visit there, shortly after his arrival in the capital, San Jose, on March 18.

As Secretary of Agriculture, Mr. Wallace was greatly interested in the promotion of agriculture in the American tropics, as a means for providing the countries to the south with products which would supplement, rather than compete with, North American agriculture, and thus afford a substantial basis for the "good neighbor" program.

At Turrialba, the Costa Rican government has provided 1,200 acres of the finest upland soil to be found in the American tropics. Formal title was transferred to the institute late last month, although initial phases of actual field work had already been in progress for some time. This locality, at 2,000 feet above sea level, was chosen because less than two hours' ride by car or train can carry the investigator through an almost complete cross section of tropical American conditions.

Scientific work at the institute is to be entirely research on the post-graduate level; no undergraduate courses are contemplated. Facilities of research stations in other Latin-American countries have already been made available. Until the war is over, only temporary buildings will be erected. However, plans for the permanent plant are already drawn up, and construction can go forward rapidly once materials and manpower are released.

Research is already in progress on rubber, cinchona, foodstuffs and tropical hardwoods. Work will begin soon on plants providing oil, fibers and insecticides.

At a press conference immediately before taking off, Vice-president Wallace expressed great interest in the plant breeding program to be carried on there, especially in the breeding of rubber trees of higher productivity and greater resistance to disease. He expressed the opinion that "Plant breeders have been making, and can and will make, as rapid progress in increasing production of natural rubber as chemists can make in the production of synthetic rubber."

The director of the new institute is Dr. Earl N. Bressman, formerly with the Coordinator of Inter-American Affairs. The secretary is José L. Colom, of the Pan American Union.

From Costa Rica the Vice-president and his party will proceed to Panama, thence southward for visits in Chile, Bolivia, Peru, Ecuador and Colombia, returning to Washington late in April. As much time as possible will be spent in the field, obtaining first-hand information about agriculture, forestry and mining in the countries visited. At his press conference, Mr. Wallace expressed regret that time does not permit visits to all the South and Central American republics on the present trip, but he added that he hopes to see these countries in the not too distant future.

Accompanying the Vice-president are Laurence Duggan, of the Department of State, and Hector Lazo, of the Board of Economic Warfare. James Le Cron, of the Office of Inter-American Affairs, went with the party as far as Panama, returning to Washington from there.—FRANK THONE.

ADVANCES IN MEDICINE AND SURGERY

"THE remarkable advances in medicine and surgery since the first World War are now paying large dividends in saving the lives of soldiers wounded in combat," is pointed out by statisticians of the Metropolitan Life Insurance Company in the official bulletin. The sulfa drugs, blood plasma and new anesthetics are listed as outstanding discoveries contributing to reduction of war wound casualties.

Gross statistics, even where available, are of little value in measuring the achievements of our military physicians, it is pointed out, for two reasons:

1. Changes in military technology and the type of warfare, including greater use of tanks, planes and other mechanized equipment, and the creation of deadlier weapons and projectiles, such as heavy and incendiary bombs, are likely to cause more numerous and more severe wounds of fighting men to-day than in the last war.

2. Better organization of medical services in the field, on the other hand, probably will result in inclusion among the wounded of some men who, in previous wars, would have been recorded as killed in action because they died of their wounds before they were found.

The report states that "Despite all this, definite indications of improvement in wound fatality rates are available from scattered sources."

Preliminary data on our Army casualties up to December, 1942, show a fatality rate of about 4 per cent. compared with 7.7 per cent. in the first World War. In the Solomons fighting, deaths from abdominal wounds were less than 5 per cent., although the rate for mortality from this type of wound in previous wars has usually been higher than 50 per cent. The fatality rate from chest wounds, formerly running over 25 per cent., was reduced in one British medical unit to about one fifth of that figure among casualties evacuated from Dunkirk.

Wound infections and gas gangrene have been relatively infrequent, largely as a result of routine use of the sulfa drugs. Tetanus has been practically eliminated by the routine protection given our men by tetanus toxoid.

Shock and hemorrhage are being successfully fought by plasma transfusions of wounded men in the field. Sedative drugs promptly given in the field are also reducing the danger of shock. In many cases these measures have made it possible to defer major surgery until the wounded could be transported away from the fighting zone to base

hospitals where more adequate surgical and nursing care can be given. Air transport has aided greatly here. With its aid, many of those wounded in North Africa were being treated in the United States only a few days after being wounded.

The problem raised in this war by burns from incendiary bombs, high explosives, gasoline and oil fires has been largely solved and many lives saved by new methods of treating burns, including plasma and the sulfa drugs, developed in the years between the wars.

THE SHORTAGE OF PHYSICIANS

A PLAN for meeting the present shortage of physicians by having the special type temporary licenses to refugee physicians issued by the War Manpower Commission was suggested at the National Conference on War and Postwar Planning for Medical Services held in New York City under the auspices of the Carlos Finlay Institute of the Americas.

The suggestion was made on an unofficial and personal basis by Dr. Frederick P. Keppel, director of the Equitable Life Assurance Society of the United States, who is now in Washington serving on the War Relief Control Board and also on a two-man board of appeals on immigration visas for refugees.

The postwar practices of American doctors now serving their country with the armed forces would be safeguarded, according to Dr. Keppel's plan, by making these special licenses good only for the duration of the present emergency. The licenses, furthermore, would be limited to practice in certain localities such as the towns that have mushroomed around war industrial centers and army training camps.

Dr. Keppel pointed out that the American people are ignorant and uninformed on the immigration problem. They are still laboring under the impression that hordes of unwashed, illiterate people are clamoring at the gates. Actually, if every application for a visa were granted, the number would be only one tenth that allowed under pre-war immigration quotas. Only about one half of the number is approved, however, and of those approved, only about one half manage to get to this country.

The immigrants to-day are to a large extent people of culture. A large proportion is made up of professional people, such as doctors, dentists, nurses and research workers, in all of which categories we have a serious shortage. Dr. Keppel's suggestion for temporary, special type licenses for physicians was made with the hope of helping to solve the problem of how to use these refugees to the best advantage of the United States and still protect the jobs of those Americans away at war.

ITEMS

THE current meningitis outbreak appears to be approaching the proportions of the 1929 epidemic, which was the biggest meningitis outbreak on U. S. Public Health Service records. For the week ending March 13, the latest on which figures are available, 514 cases were reported throughout the nation, exclusive of Rhode Island, whose report has not yet been received. This state reported 19 cases the previous week. A similar figure from that state for the week just ended will bring the week's total up to or over the 531 cases for the preceding week, ending March 6. Through the week of March 6 a total of 3,515 cases of meningitis has been reported this year, a figure more than 25 per cent. above any other nine-week period in the past sixteen years. The total of 4,029 cases from January 1 through March 13 this year is higher than any other year since 1937 when 5,484 cases were reported during the entire year. When the present outbreak will be over is impossible to predict. In nine of the past sixteen years the peak of the meningitis season has come before the end of March. In five years it came in April and in two years as late as May.

SUCCESSFUL use of blood plasma to fight shock from fever treatment for gonorrhea is reported, apparently for the first time, by Lieut. Arthur M. Pruce, chief of the section of physical and fever therapy at Stark General Hospital, Charleston, S. C. The report appears in the *Journal* of the American Medical Association. Lieut. Pruce explains that he is reporting this use of plasma "because our armed forces have instituted a rapidly expanding program of fever therapy to treat venereal diseases" and shock is one of the more dangerous complications of this kind of treatment. Rise in the pulse rate and fall in blood pressure, indicating impending collapse, forced discontinuance of the fever treatment after about five and one half hours in the case Pruce reports. In spite of treatment with the usual antishock measures, the patient went into shock six hours after the fever treatment was discontinued. At this point about half a pint of blood plasma was injected into the patient's vein. Within 20 minutes the patient recovered from the shock condition. "Interestingly enough," Lieut. Pruce adds, "the patient was cured of gonorrhea in spite of only five and three quarters hours of therapeutic fever."

SEEDS have assumed an importance out of all proportion to their size, and crop prospects are debated daily in Congress. Means for making each seed more efficient, covered by newly-granted U. S. patent 2,313,057, therefore take front-rank position in the week's news of inventions, along with more conventional mechanical, chemical and military novelties. Patentee is Albert C. Fischer, of Chicago. The invention, briefly, is a simple method for making each seed carry into the soil a small provision of fertilizer, fungicide, insecticide and (in the case of legumes) nitrogen-fixing bacteria that it needs in its first day or so after germination. This is accomplished by coating the seed with a water-soluble glue into which the initial life-needs of the seedling-to-be are impregnated. To protect the seed against possible ill effects of too-long contact with fertilizer and fungicidal compounds, it is first covered with a coating of neutral glue, then with one or more coats containing the chemical and bacterial growth aids.

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CONTRIBUTIONS OF THE MEDICAL CORPS OF THE ARMY TO THE PUBLIC HEALTH LABORATORY[1]

By COLONEL EDGAR ERSKINE HUME

MEDICAL CORPS, UNITED STATES ARMY

DR. WILLIAM HENRY WELCH was a long-time friend and constant user of the Army Medical Library. Billings, its great librarian, had selected Welch for his professorship at Johns Hopkins. Not long before his last illness Dr. Welch was in the library and, in the course of one of his delightful conversations, said: "I have been asked on more than one occasion what have been the really great contributions of this country to medical knowledge. I have given the subject some thought and believe that four should be named: (1) The discovery of anesthesia; (2) the discovery of insect transmission of disease; (3) the development of the modern public health laboratory, in all that the term implies; and (4) the Army Medical Library and its Index Catalogue."

"Popsy," as he was affectionately called, was more apt to utter words of wisdom than to write them. The Librarian was so struck by this pronouncement that he reduced it to writing immediately after Dr. Welch had left. I bear witness, for I was the Librarian.

What is "the modern public health laboratory"? I assume that Dr. Welch meant not a mere building with a miscellaneous collection of apparatus, but the concept of the sum of the knowledge of chemical, physical and biological procedures which have added to our scientific knowledge or which aid in the maintenance of health of individuals and communities. In

[1] Presented at the first session of the Laboratory Section of the seventy-first annual meeting of the American Public Health Association, St. Louis, Mo., October 27, 1942.

other words, laboratory techniques of many kinds but all ultimately at the service of the health officer and his associates.

To this concept of a sum of knowledge to-day at the command of those who seek to preserve the nation's health, the Army Medical Department has made great contributions of lasting worth. Many of them are so well appreciated that they hardly require mention. Others are not always known to be contributions by the Army or its officers. To-day, when folk are thinking about their armed forces, it is worth while to review some of these contributions. My list is not an attempt at a complete catalogue. Of course, the Army can only claim credit for the work of its full-time officers or by those whose work was done while in the military service.

America's First Bacteriologist

In any consideration of the contributions of Army medical officers to laboratory procedures, one must immediately think of the great Sternberg, father of American bacteriology. George Miller Sternberg (1838–1915), who was our Surgeon General at the time of the Spanish-American War, is one of America's great scientific figures. Perhaps the best summary of his career is to be found on his monument at Arlington National Cemetery. The text was written by Dr. William Henry Welch:

> Pioneer American Bacteriologist. Distinguished by his studies of the microorganism of pneumonia and scientific investigations of yellow fever, which paved the way for the experimental demonstration of the mode of transmission of that pestilence. Veteran of three wars, brevetted for bravery in action in the Civil War and the Nes Percés War. Served as Surgeon General of the U. S. Army for a period of nine years, including the Spanish-American War. Scientist, author, and philanthropist. M.D., LL.D.

Space precludes a full account of all that Sternberg did in the way of laboratory research, but the great things are so great as to make details unnecessary. He became interested in the new science of bacteriology at its beginning. In 1881 he discovered the pneumococcus, pathogenic agent of lobar pneumonia, which he found constant in his own sputum. It was found to be identical with the organism described by Pasteur in the same year. Later, 1885, Sternberg demonstrated that his *Micrococcus pasteuri* is in fact the capsulated micrococcus found in the rusty sputum of pneumonia patients. While Frankel is entitled to credit for this important discovery, it was Sternberg who first recognized and described the organism.

In 1882, while on duty at Fort Mason, California, Sternberg demonstrated and photographed for the first time the tubercle bacillus, which had been discovered in that year by Koch. Sternberg's photomicrographs of this and other organisms are preserved in the Army Medical Museum. Many of them are unexcelled even by use of the most modern photographic apparatus and lighting devices.

His text-books on bacteriology played a most important part in the development of that science in the United States. In 1880 he translated Antoine Magnin's "Les Bactéries" (1878) from the French. In 1884, under the authorship of both Magnin and Sternberg this work was greatly enlarged and brought down to date. In 1892 there appeared Sternberg's "A Manual of Bacteriology," a milestone indeed. All these works contained many of Sternberg's own photomicrographs as illustrations.

Sternberg must also be remembered for his valuable work on the etiology of yellow fever. Though he did not discover the pathogenic agent, he was able to prove that many supposedly causative organisms were not concerned. The value of this negative work must not be overlooked. Moreover, it was Sternberg who selected Walter Reed for study of pathology of yellow fever in Welch's laboratory at Johns Hopkins. He always gave every support to Reed in his yellow fever work.

Typhoid Fever Prophylaxis

Major Walter Reed (1851–1902) is best remembered for his epidemiological studies which demonstrated that yellow fever is transmitted by the mosquito. His other great contribution to public health is almost as important—the studies of typhoid fever in the Army camps at the time of our War with Spain in 1898, which showed that the disease is transmitted not merely by contaminated drinking water, but by direct contact as well. "Food, fingers, and flies," as Osler put it, or "Dirt, diarrhea, and dinner," as Sedgwick said. Reed's associates in this work were Majors Victor Clarence Vaughan (1851–1929) and Edward Oram Shakespeare (1846–1900).

Typhoid fever is an ancient enemy of soldiers. In all our wars, prior to the first World War, it has taken terrible toll of our fighting men. Between the Spanish and World Wars something happened to reduce this incidence. It was the immunization of troops. Sir Almroth Wright, professor at the Royal Army Medical College, London, had practiced immunization by the inoculation of killed cultures of the typhoid bacillus, but in the South African War there was reported a discouraging "negative phase," so that in 1903 Wright's typhoid prophylaxis was prohibited. It was later again put into use in the British Army, but as a voluntary measure.

The United States Army was first to adopt compulsory typhoid prophylaxis. Surgeon General Robert Maitland O'Reilly (1845–1912) became interested in Wright's work and sent the brilliant Captain Frederick Fuller Russell to Europe to investigate. Russell

was then a professor at our Army Medical School, and to-day, a Brigadier-General, is professor emeritus at Harvard, having been the head of the International Health Board. Russell became convinced of the effectiveness of the practice and in 1909 was given the gigantic task of immunizing the entire United States Army against this disease. From a morbidity of 173 cases in 1909 he brought the number to nine in 1912, the strength of the army remaining about the same. In 1911 the prophylaxis became compulsory. During the mobilization on the Mexican Border, Russell vaccinated some 20,000 men against typhoid, and the only case that occurred in the camps was that of a non-vaccinated teamster.

The World War was the test of the ultimate worth of this measure. Statistics are available, but they may be summed up with the simple statement that, had the rates of the Spanish War period prevailed, we would have had not 1,572 cases of typhoid fever, but half a million!

The corollary of this is the laboratory procedure required for the production of vaccine for this universal military use. It is a huge task. Not only have the Army Medical School Laboratories manufactured all the typhoid vaccine used by our Army, but likewise that for the Navy and the Public Health Service, as well as much for the armed forces of allied nations. At the time of the outbreak of the present war, the Army Medical School was manufacturing more than 2,500 liters of the vaccine per year, enough for a million prophylaxes—an enormous quantity, but even that has had to be exceeded to meet new war needs.

Purification of Drinking Water

No activity of a modern public health laboratory is more important than the examination of water for potability. The work of Army medical officers along this line has been of exceeding importance. It has not been many years since people thought that by taste alone one might judge of the quality of drinking water. But once the danger of water-borne diseases was explained to the public they tended to attribute all intestinal disease to contaminated water.

The proper purification of drinking water therefore became a major problem, and with it the proper technique for laboratory examination of water samples. Filtration was tried at first. The Darnall Filter, devised by Brigadier-General (then Major) Carl Rogers Darnall (1867–1941), was an ingenious adaptation of the principle of mechanical filtration to field needs. Darnall made a far more important contribution to water purification, however. This was the introduction of the use of liquid chlorine for the purpose in 1910. His experimental work, upon which the method is based, was done in the laboratories of the Army Medical School, where he was professor of chemistry and of which he subsequently became the commandant. General Darnall's priority in this use of liquid chlorine is attested by basic patents in this and other countries, the validity of which has been upheld by the courts.

For chlorination of water in the field there have been a number of devices developed in the Army's laboratories. Best known, and still in regular use, is the Lyster Bag, devised by Colonel (then Major) William John L. Lyster. It is a specially woven bag of 30 gallons capacity in which chlorination is effected by the use of calcium hypochlorite. More recently a high-test hypochlorite has been adopted which is more stable and releases a greater amount of chlorine. The Lyster Bag, or modifications thereof, is used in several foreign armies and navies.

Bacteriology of Gunshot Wounds

Prior to important laboratory studies by Colonel Louis Anatole LaGarde (1849–1920) of the Medical Corps, it was commonly supposed that the great heat generated in the firing of a rifle sterilized the bullet. It was, therefore, thought that infections of gunshot wounds were due to contaminations from the clothing, the soil or other means.

Colonel LaGarde doubted this, and by means of a long series of experiments showed that an infected bullet fired from a rifle is still capable of transmitting infection to the tissues into which it strikes. LaGarde's first paper appeared in the *New York Medical Journal*, 1892. In the years following he published a large number of reports of his laboratory studies of the effect of small arms projectiles. Even now, twenty-two years after LaGarde's death, his monograph "Gunshot Injuries" (1914; second edition, 1916) is not outmoded.

More recent laboratory work in the medical side of ballistics was done by Lieutenant-Colonel Calvin Goddard, an honor graduate of the Army Medical School. Goddard is a pioneer in the identification of bullets. By means of twin comparison microscopes he shows whether the same rifle markings are found on an unknown bullet and one fired from the suspected weapon. The medico-legal importance of this work is very great. Goddard also has made extensive studies of powder marks, and other subjects connected with forensic ballistics.

In the laboratories of the Army Medical Museum and in a series of field experiments, Colonel George Russell Callender, assisted by Staff Sergeant R. W. French, has made important contributions to our knowledge of the explosive effect of high velocity projectiles.

WILLIAM BEAUMONT AND THE PHYSIOLOGY OF DIGESTION

The pioneer studies of the physiology of digestion made by Surgeon William Beaumont (1785–1853) of the Army may, at first sight, not be considered contributions to the public health laboratory. Yet they, in fact, are. Though Beaumont did his work far from the centers of medical science and in primitive cabins and tents, it was really research of the first magnitude. As already said, it is not the building that makes the laboratory.

Beaumont is one of the best known of Army medical officers because his courage and skill have somehow caught the popular imagination. Recently a painting by Dean Cornwell has depicted his sitting by the bedside of his famous patient, Alexis St. Martin, a Canadian half-breed Indian.

St. Martin was accidentally shot in 1822, a gastric fistula resulting. This never healed, so that Beaumont, under whose care the patient came, had an unusual opportunity to study the physiology of digestion at first hand. The story of Beaumont's contract with the temperamental St. Martin is one of the thrillers of medical history. The patient, for all that he was receiving a regular salary from Beaumont's slender army pay, had a way of running away, only to be discovered by the energetic and patient Beaumont, so that the studies would be resumed. Beaumont's account of his work is found in his "Experiments and Observations on the Gastric Juice, and the Physiology of Digestion" (1883). "To the bibliographer," said Osler, "there are few more treasured Americana than the brown-backed, poorly printed octavo volume of 280 pages." The pioneer physiologist of the United States, and the first to make a contribution of enduring value, his work remains a model of patient, persevering research.

When Beaumont's famous patient died in 1880, at an advanced age and the father of twenty children, Osler tried to obtain his stomach for the Army Medical Museum. But there came a telegram of warning—"Don't come for autopsy: will be killed"—and St. Martin's neighbors guarded his grave by night.

MALARIA

Malaria is a disease of the utmost interest to armies. It is perhaps the most important single cause of disability in the tropics, where our army and so many other military forces are engaged. It is interesting that the important researches as to the cause of malaria and its mode of transmission have been made by military surgeons. In 1880 Charles-Louis-Alphonse Laveran (1845–1922), a surgeon in the French Army, discovered the parasite of malaria while serving in Algeria. In the following year he described the parasites in all their aspects. In 1897 Sir Ronald Ross (1857–1932), then a Major of the Indian Medical Service, demonstrated the mosquito as the vector of malaria. On these discoveries our war on malaria is based.

The United States Army was the first to undertake anti-malarial work on a large scale. From 1898 onward our troops were given mosquito nets, on the recommendation of Major (now Brigadier-General) Jefferson Randolph Kean, and instructed in their proper use. The work of Gorgas in Cuba and later in Panama in the eradication of mosquitoes, malarial as well as those of yellow fever, is known to all and sundry.

Colonel Charles Franklin Craig first demonstrated the intracorpuscular conjugation of malarial plasmodia as the cause of latency and relapses, and of the existence of carriers.

While the extensive and efficient anti-malarial work done by the Army in the field is hardly to be called a contribution to the public health laboratory, yet much of it rests on proper laboratory identification of mosquitoes, as well as the malarial parasites themselves. Even in the present war our officers in the West Indies, under the direction of Colonel Leon Alexander Fox, have found that *Anopheles bellator,* a mosquito not hitherto incriminated, is a vector of malaria.

VENEREAL DISEASE CONTROL

The laboratory side of the Army's relentless war against venereal diseases came long after many other modes of attack had been used. The chemical laboratory has developed chemical prophylaxis for use in preventing venereal infection. This was not introduced by American medical officers, but the work of Metchnikoff and others was confirmed here, and it was the United States Army which first used this measure on a wide scale. Much research has been done in the way of searching for better chemical agents than the colloidal silver solution and the calomel ointment, and perhaps such will be successful. In the meantime, credit is due at least for effort and for disproving extravagant claims made for certain chemicals and various proprietary products.

In the serodiagnosis of syphilis the Army has done much. Wassermann's test was early tried, and the Army was among the first to require serological examinations in suspected cases of syphilis. Colonel Charles Franklin Craig has done outstanding work in this phase of serology. His monograph "The Wassermann Test" (1918) is authoritative and of lasting value.

The Kahn test for syphilis, now used in the Army together with the Wassermann test, and used in the Navy exclusively in the diagnosis of syphilis, is the

outcome of work done by Major Reuben Leon Kahn of the Sanitary Corps (Army Reserve). Though the Army can not claim any share in Major Kahn's valuable work in the development of the test that bears his name, it can take pride in its support of the work. Major Kahn for many years used to be placed on active duty as a reserve officer, in the laboratories of the Army Medical School, where studies were conducted as to the use of this test in the military service, including service in the field.

One of the first American physicians to use Salvarsan when that product, still known as "606," was brought out by Professor Paul Ehrlich, was Captain (later Colonel) Henry James Nichols. He collaborated with Ehrlich in giving practical tests of the drug in the early stages of its investigation (1910). With Craig, Nichols did a series of researches on the effect of the administration of salvarsan on complement fixation tests for syphilis.

Laboratory Work in Puerto Rico Leads to Successful War on Hookworm

In 1899 Colonel (then First Lieutenant) Bailey Kelly Ashford (1873–1934) began his laboratory studies of what was known as Porto Rican anemia or tropical chlorosis. The cause was unknown, but Ashford soon showed that it was the New World type of hookworm, *Necator americanus*. His account, in his breezy style, of his finding laboratory evidence of infestation by this helminth is interesting:

> Who had ever heard of a whole agricultural class dying of an epidemic of pernicious anemia? It was unthinkable. Hold on! Look at those eosinophiles. What are they doing so numerous in pernicious anemia? . . . Oh, yes, now I remember something I read out of a journal not long ago. A man by the name of Brown found these prominent strawberry looking eosinophiles to be increased in an infection by the worm causing pork measles. Maybe these animals have worms! And I began to laugh; but I sat up far into the night until the chilly morning land breeze began to blow. And I went to bed still intrigued with eosinophiles shooting like comets before my eyes. The idea that a frightful epidemic anemia with a high death rate might be caused by anything so commonplace as worms![2]

As a result of Ashford's findings and recommendations a campaign was begun in our newly acquired island of Puerto Rico, and the inhabitants by tens of thousands were successfully treated. Ashford's work has been duplicated in many parts of the tropical world.

Dysentery

The contributions to our knowledge of both amebic and bacillary dysentery made by Army medical officers have been many and important. As early as 1900 Acting Assistant Surgeon (now Colonel, retired) Charles Franklin Craig was writing on his laboratory and other studies of amebic dysentery as observed in the military hospital in San Francisco. Work on both forms of dysentery was begun about the same time in the Philippines by Assistant Surgeon (later Colonel) Richard Pearson Strong and Dr. William Everett Musgrave, hospital steward. One of the several types of dysentery bacillus bears the name of Colonel Strong, who isolated it in the Army's laboratory in Manila.

Colonel Craig in 1916 found that an epidemic of amebic dysentery among troops on the Mexican Border was fly-borne. This officer's monographs on amebic dysentery contain important reports of laboratory work. "The Parasitic Amœbæ of Man" (1911) and "Amebiasis and Amebic Dysentery" (1935) are valuable reference texts.

Pneumonia

Studies of pneumonia have been of interest to Army medical officers for many years. The discovery of the pneumococcus by Surgeon General Sternberg has already been mentioned. The monumental "Medical and Surgical History of the War of the 'Rebellion'" (6 volumes totaling 4,846 pages) and "The Medical Department of the United States Army in the World War" (17 volumes, totaling 160,291 pages) contain much on laboratory studies of pneumonia. In both works one finds that the Army was at the forefront of medical advance.

In 1917, at the time of the mobilization on the Mexican Border, Major (then Colonel) Henry James Nichols (1877–1927) showed by his laboratory work that the disease was principally due to Type I and Type II of the causative organism.

Since 1933 the Army has been producing pneumonia vaccine in the laboratories of the Army Medical School. It has been distributed to various governmental and other agencies for trial. Reports, though not final, are most encouraging. Pneumonia prevention by the use of Felton's polysaccharide derivative of the pneumococcus, containing a soluble substance, was begun by the Army in 1934. It was extensively tried in the Civilian Conservation Corps camps. Final data for the present war period are not yet available.

Trench Fever

In the first World War it was found that there was present an acute communicable disease, not unlike but distinct from typhus fever. Our British allies gave it the name "Trench Fever." It was found to be louse-borne. The most important studies of this "new" malady were made by the Medical Research Committee headed by the veteran scientist, Colonel

[2] "A Soldier in Science," 42–43.

Richard Pearson Strong, formerly of the Regular Army but then professor of tropical medicine at Harvard. Strong and his associates showed that the filterable infective agent is present in the blood plasma. The disease was reproduced by injections of the blood of patients, either intravenously or intramuscularly.

THE U. S. ARMY BOARD FOR STUDY OF TROPICAL DISEASES

In considering the Army's contribution to the public health laboratory one is apt first to think of the Tropical Board, as it is known in the service. Some of its work is mentioned elsewhere in these notes.

With the acquisition of tropical possessions after the Spanish-American War, our Army fell heir to a new category of medical problems. Theretofore we had seen tropical diseases only in a few regions in our far South and never to the extent found in the true tropics. Surgeon General Sternberg, with his usual vision, created in 1900 the *Board for the Study of Tropical Diseases,* the work of which was done in Manila. The members of this first Board were First Lieutenant (later Colonel) Jere Black Clayton, First Lieutenant (later Colonel) Richard Pearson Strong, Acting Assistant Surgeon William Jephtha Calvert, Acting Assistant Surgeon Joseph J. Curry and Hospital Steward Dr. William Everett Musgrave. By means of laboratory research this board contributed largely to the sum of knowledge of plague, cholera, filariasis, dysentery, typhoid fever, blackwater fever, surra, smallpox and other maladies. In 1906 the members of the board were Captain Percy Moreau Ashburn and First Lieutenant Charles Franklin Craig, both later Colonels. They worked on filariasis, dengue, tsutsugamushi fever and intestinal parasitic infections.

As the years went by, the board, with various interruptions, because of what we call "the exigencies of the service," continued its work. In 1909, upon the recommendation of two of its members, Captain (now Colonel, retired) James Matthew Phalen and Captain (later Colonel) Henry James Nichols, the diet of Filipino scouts was changed, with a reduction of beriberi. Beri-beri was long the subject of consideration by the board. In 1913 Colonel Edward Bright Vedder published his valuable monograph on this disease.

In 1910 Colonel (then Major) Eugene Randolph Whitmore established the Pasteur Institute in Manila.

There is not space to consider all the diseases studied in the laboratories of the Tropical Board, many of which were little known in the continental United States, including paragonomiasis, schistosomiasis, filariasis, amebiasis, oidiomycosis, yaws, blastomycosis, sprue, aihnum, cholera, trypanosomiasis and bacillary dysentery. The board also considered certain diseases well enough known at home but which manifested other forms in the tropics, such as uncineriasis, tuberculosis and typhoid fever.

More recent members of the board, such as Colonels George Russell Callender and James Stevens Simmons, have done much valuable work in laboratory studies of tuberculosis, malaria and other diseases. Surgeon General Robert Urie Patterson removed the board from the Philippines to the Canal Zone.

Meleney has called the first two decades of the present century "The Golden Age of Tropical Medicine in the United States," for then yellow fever, malaria, hookworm infection, typhoid fever and the dysenteries were largely brought under control. Certainly the laboratories of our Army medical officers brought forth many of the discoveries to this end. They must ever be considered as leaders among our "Ambassadors in White," to use Morrow's term.

ROENTGENOLOGY

Since the x-ray is an important laboratory aid to medicine and since its use has certainly resulted in improving the health of the public, it is not out of place to consider pioneer work done by the Army in this connection.

Our medical officers became interested in the new diagnostic aid immediately after Roentgen's discovery in 1895. Apparatus of various types was placed in use during our war with Spain, being chiefly employed in locating bullets. The Army was the first American group to use the x-ray on a large scale.

Alas, the Army had its martyrs to this new science, as did others. Mrs. Elizabeth Fleischmann Ascheim (1859–1905), though not a nurse, was a pioneer in roentgenological work and carried on her studies at the Presidio Division Hospital of San Francisco (now known as the Letterman General Hospital). Working without protection she fell a victim to cancer. One of our officers, Lieutenant Colonel Eugene Garland Northington (1880–1933), likewise lost his life in this way. His arms were amputated, one after the other, but even when entirely helpless, he retained his courage to the end, amid the suffering that goes with such a tragic fate.

LABORATORIES OF THE ARMY MEDICAL MUSEUM

The Army Medical Museum of Washington is not merely a place where unusual objects of medical interest are preserved and displayed. It is much more than a museum, being one of the country's important research institutions. It is the largest medical museum in America and probably in the world.

Much valuable research in pathology, bacteriology, helminthology, entomology and other sciences related to public health and preventive medicine has been

done in this great institution. The building was erected in 1887 and served for a time, not only for the Army Medical Museum and its sister the Army Medical Library, but also for the Army Medical School, when it was first established. In a small annex there are a series of rooms originally built for the bacteriological laboratories of Major Walter Reed. In the early days of bacteriology it was considered dangerous for a bacteriological laboratory to be too near to other buildings! There was still something of the old concept of infection flying through the air from the sick to the well, particularly when wafted by a malevolent breeze. These historical rooms are now used as offices by the museum.

A number of the more important clinical societies of this country place their entire pathological collections in the Army Medical Museum for safekeeping, display and study. Thus the museum has become the central point for the exchange of information and ideas. The Curator of the museum regards this as the institution's most important present function. The institutions which have thus far established Registries, as they are known, in the Army Medical Museum, are the American Academy of Ophthalmology, the American Academy of Oto-Rhino-Laryngology, the American Dental Association, the American Society of Clinical Pathologists, the American Association for Thoracic Surgery, the American Association of Pathologists and Bacteriologists, the American Urological Association and the American Academy of Dermatology and Syphilology. Here are a series of unrivaled collections of pathological material, both gross and microscopic, available to physicians everywhere.

The Army Medical Museum has, among other duties, that of making gross and histological studies of material sent for diagnosis from all stations throughout the army. When a piece of tissue, removed at biopsy, is sent to the museum for study to determine malignancy, reports are sent, where necessary, by telegraph. The museum is also prepared to aid in the identification of insects, snakes, etc. Through close cooperation with other federal agencies the museum's sphere of usefulness is widened

LABORATORIES OF THE ARMY MEDICAL SCHOOL

One of the most important features of the Army Medical School is its laboratories. There are excellent facilities for chemical, serological, bacteriological and other research, as well as arrangements for laboratory aids in diagnosis. Many of the Army's most important researches have been conducted here.

Elsewhere mention has been made of the preparation of vaccines at the Army Medical School. As a training center it is an indispensable cog in the machine which turns out trained medico-military personnel for the military service. Not for nothing did Professor Welch call the Army Medical School "America's oldest school of preventive medicine."

THE MEDICAL DEPARTMENT EQUIPMENT LABORATORY

At Carlisle Barracks, Pennsylvania, in close cooperation with the Medical Field Service School, the Army maintains a laboratory for the development and testing of equipment for use by the Medical Department in the field. Many of the pieces of apparatus now in common use grew from experimental models made at this laboratory. The range of material considered is the widest. From the latest types of ambulances to new first-aid packets to be carried by the individual soldier, material has been brought out. This may not be a laboratory in the sense in which the term is used by the chemist or the bacteriologist, but it is a laboratory nevertheless, and an efficient one as well.

AVIATION MEDICINE LABORATORIES

Since most aviation accidents are due to the faults of the pilot rather than the faults of the aeroplane, anything that serves to remove the chance of unfit men attempting to pilot aircraft, must be reckoned a measure of preventive medicine. Special laboratories for the study of the physiology of altitude flying and other phases of aviation have been maintained by the Army Medical Department since the first World War. Much good has resulted.

The work of such laboratories consists of research, and likewise in the training of the men who have the duty of examining flyers. Some men are physically incapable of ever becoming pilots. Others are good pilots at times only. No man is at his maximum physical efficiency all the time. The flight surgeon has the task of being sure that only physically fit men are allowed to fly.

RESEARCH ON WARFARE CHEMICAL AGENTS

The Medical Department of the Army has nothing to do with the infliction of wounds or death, but must know how such things are brought about. Research, therefore, pertaining to the effects of warfare gases on the human or animal body is of paramount importance.

Work of this nature began with the first World War. Then defensive measures were entrusted to our branch of the military service. Through that war and in the two decades that intervened before the outbreak of the present conflict, specially qualified medical officers have devoted much time and thought to studies of warfare chemical agents.

At our Chemical Warfare School at Edgewood

Arsenal, Maryland, we have a Medical Laboratory. Therein are conducted experiments on the effect of the many kinds of warfare gases and other chemicals on the individuals and on large groups of human beings. The studies include pathology of warfare chemical wounds, chemical means of neutralizing warfare agents and the efficacy of the several types of gas masks.

Obviously work of this kind must, from its very nature, be highly confidential in times like these, but I do not exaggerate when I say that the things that our research men are doing are quite in keeping with the discoveries and advances made in other fields of scientific work.

DENTAL FOCAL INFECTION

It was one of the greatest military surgeons, Surgeon General Benjamin Rush (1745–1813), Signer of the Declaration of Independence, who first suggested that infected teeth might be the cause of disease. In working on problems pertaining to this, our Medical Corps and Dental Corps have worked in close cooperation.

Major Fernando Emilio Rodriguez (1882–1932), Dental Corps, and American officer born in Puerto Rico, may be regarded as the greatest contributor to dental bacteriology since Müller, the German investigator of half a century ago. His researches as to the cause of dental caries began in 1921. By the development of a special technique he was able, at the laboratories of the Army Medical School, to isolate and classify a high acid-producing group of bacteria, *Lactobacillus odentolyticus,* which he classified morphologically as Types I, II and III. He demonstrated Type III as the primary etiological agent in enamel decay, identifying the organism with the flora of the dentinal tubules in caries.

VETERINARY RESEARCH

The Veterinary Corps is one of the several corps of the Medical Department of the United States Army. Medically important are certain researches by its officers, particularly its present chief, Brigadier-General Ray Alexander Kelser, into those diseases of animals which may be communicated to man.

Kelser demonstrated the transmission of equine encephalomyelitis by mosquitoes, ten species of *Aedes* already having been shown capable of such transmission. Several thousand cases occurred last year in human beings in Minnesota, the Dakotas and adjacent parts of Canada.

Kelser, a member of the Tropical Board, did important work in developing a vaccine for use against Rinderpest, long a serious disease among cattle in the Philippines. This officer also proved the supposition of Mitzmain, that *Tabanus striatus* is the vector of surra, a uniformly fatal equine disease in the Islands. A rabies vaccine, in which the virus is inactivated by chloroform, has been introduced by Kelser and has been found to be more effective than vaccine made by other methods.

CONCLUSION

These, then, are some of the contributions made by medical officers of your army to the mass of scientific knowledge ever available to the public health worker in his war on disease. Many others could be mentioned, but these will suffice to remind you that while our medical officers have always performed the duties expected of them in the military service they have likewise found time to do much scientific work of general value. To do this our men have had to be willing to work through long hours and to do things not required of them as mere routine. They have done so willingly and gladly, always remembering that whatever they could learn for the good of humanity was entirely in keeping with their prime military function of conserving the fighting strength of America's soldiers.

THOMAS JEFFERSON, THE SCIENTIST

By FREDERICK E. BRASCH
LIBRARY OF CONGRESS

THOMAS JEFFERSON probably had the most forward-looking mind of his day in America. No other American of his generation so deserves to be termed pioneer, prophet and man of the age. His advocacy of democracy, education, religious toleration and the application of scientific knowledge to the common pursuits of life place him far in advance of his day. No contemporary of his, with possibly one exception, Benjamin Franklin, had so varied an interest in the pursuit of science as Jefferson. And yet, no satisfactory or full story of this interest and accomplishments has been published. There is a wealth of material available and it is therefore one proper function of this Bicentenary to reveal and evaluate Jefferson as a man of science.

Much evidence remains of his broad and analytical interest in matters of scientific import. To mention those of more lasting value, several of the various federal scientific bureaus of the United States are the direct result of Jefferson's farsightedness. Some of these bureaus had their origin while he was Secretary of State. The National Bureau of Standards is one, the germ of which originated in an elaborate report of Jefferson dated July 4, 1790, and presented to Con-

gress on July 13. This report contained suggestions of a plan for establishing uniformity in the coinage and weights and measures of the United States.

The Patent Office was virtually founded by Washington and at the time of its creation, Jefferson was Secretary of State. He became *ex officio* the Keeper of the Records of the Patents and was the most active examining member of the board and therefore its first administrator. The scientific foresight which he exercised at this time must be considered the cornerstone of our Patent System and laws. In 1806 President Jefferson made a recommendation for a Coast Survey to Congress, which took favorable action on February 10, 1807, and authorized the President to cause a survey to be made of the coasts of the United States, including islands, shoals and all other physical features deemed proper for completing an accurate chart of every part of the coast. To-day a continuation of this project is known as the U. S. Coast and Geodetic Survey. During Jefferson's second term much agitation was given to the question of establishing a first meridian within the United States. This was to be similar to the zero longitude at Greenwich, England. Jefferson's thorough knowledge of astronomy and mathematics together with the complementary subject of navigation enabled him to give much encouragement to members of Congress who wished to establish this standard longitude. These discussions led finally to the establishment of the Naval Observatory and Hydrographic Office.

Jefferson, like many of his contemporary men of science, was unusually active in noting the daily climatic changes. His observations were made with high-grade thermometers, barometers and his weather vane, laying the foundation of the U. S. Weather Bureau long before it was actually organized. His own manuscripts of those observations are still extant.

The one great passion of Jefferson for pure science is revealed in his study of paleontology. Jefferson is correctly known as the Father of American paleontology. When Jefferson went to Philadelphia to be inaugurated Vice-President, he carried with him a collection of fossil bones, together with a paper containing the results of his study which was later published in the *Transactions* of the American Philosophical Society. Jefferson apparently never took up the evolution question of his study of "antiquities" but confined himself to the acquisition of bones and the straightforward description of species. He felt that the time was not right for theories.

At his home in Monticello in Charlottesville, there are many evidences of his inventions and devices for labor-saving. The most ingenious is the weather-vane on the roof of the porch, which is connected by a rod running through to a compass on the ceiling. The compass has a pointer which shows the direction of the wind according to the position of the vane and nearby is an outside clock over the door giving the time. This same clock has a second face which is visible in the main entrance hall. It has a unique contrivance for winding which is done once a week. The arrangement is called a "fox and geese ladder." There are weights on both ends of the cable which is extended to both sides of the room. On the right wall there are marks at definite regular intervals giving the days of the week. When the clock is wound up the weights indicate Monday and by Saturday the weights have reached the floor. There is also a double-glass door between the entrance hall and another room, which can be opened or closed with one hand, thus automatically opening or closing the other half.

As a mathematician Jefferson was proficient in the use of logarithms and the study of geometry. This he was able to use in his architectural designing. Jefferson also had a keen appreciation of the advanced study of mechanics and optics which was evident in his various comments concerning Newton's "Principia."

To continue our understanding of Jefferson's encyclopedic mind he discussed in his letters the practice of medicine and vaccination as well as the practical and theoretical understanding of agriculture. He did not allow any subject to be neglected. He recognized and appreciated the difficult aspect of each study and emphasized, whenever possible, its application to technique and life. His relation to men in all walks of life, particularly to men of science, is vividly reflected in his voluminous correspondence. Jefferson's position in science was recognized and honored by his being elected president of the American Philosophical Society for five consecutive terms.

Jefferson's fine library bears testimony of his great interest in and his desire to maintain constant touch with the progress of science and technology. All his varied scientific pursuits, as evidenced by both his correspondence and his library, convey some idea of the greatness of Jefferson as a man of science and his love for the tranquil pursuit of nature's laws. Politics was a duty to perform; science was his real joy of life.

OBITUARY

CHARLES SCHUCHERT
1858–1942

PROFESSOR CHARLES SCHUCHERT, distinguished student of Earth's history, noted paleontologist and foremost paleogeographer of our times, died in New Haven, Connecticut, on November 20, 1942, at the age of eighty-four years. To the end of his days he continued his active research with a vigor and eagerness

that amazed and inspired his younger colleagues. After his eightieth birthday he completed and published two great volumes, and left a third in typescript at his death.

Professor Schuchert was born in Cincinnati, Ohio, on July 3, 1858, and grew up among the fossiliferous hills that have nurtured so many American paleontologists. His father was a manufacturer of furniture, and Charles spent his youth growing up with the business which he seemed destined to inherit. He was twenty-six years of age when the scientific instinct became too strong and he forsook the business world to become a paleontologist.

At that time he was poorly equipped for a scientific career, his formal education being limited to the sixth grade in grammar school plus a year in business college and courses in mechanical drawing in night school. But the spark of genius was there, driving him to seek his own education with eagerness and singleness of purpose. At first his reading was limited to the literature on fossil brachiopods, but gradually his interests widened, and in later years the breadth and extent of his reading were phenomenal. During the early years of his self-education, moreover, he was assistant in turn to E. O. Ulrich, James Hall, N. H. Winchell, Charles E. Beecher and C. D. Walcott. Thus he had almost twenty years of apprenticeship to great leaders of American paleontology, for the last ten of which he was assistant curator of invertebrate fossils at the U. S. National Museum. In 1904 he was called to Yale as professor of historical geology and curator of the geological collections in Peabody Museum, a post in which he earned honors and renown for himself and brought great distinction to Yale.

The range of Professor Schuchert's contributions to geology was wide, and his influence on our science will persist long after his passing. He was drawn first to paleontology through the hobby of collecting fossils in the hills about Cincinnati. From childhood he found in them an irresistible fascination, and while still engaged in the furniture business he had built up a notable cabinet of fossil brachiopods and was spending his evenings poring over such technical literature as he could find, learning to identify and classify his collections. Apprenticeship to Ulrich, and later to Hall, gave him more leisure for study and free access to great collections and fine libraries, and he set to work with amazing energy to learn all that could be known about the Brachiopoda. He had a penchant for system and orderliness that was reflected in his first large work, now a classic, entitled, "A Synopsis of American Fossil Brachiopoda, Including Bibliography and Synonymy." This work (1897) was followed shortly by the chapter on Brachiopoda for the well-known Zittel-Eastman "Textbook of Paleontology" (1900). The taxonomic scheme which he then collated from the literature included many original contributions and, with subsequent emendations by Schuchert, has remained the working scheme of all American students for now almost half a century. Two other notable volumes on this group indicate that his interest in the brachiopods persisted to the end of his life. The first of these, written with C. M. LeVene in 1929, is a catalogue of all the brachiopod genera and genotypes, and the second, published with G. Arthur Cooper in 1932, is a profound systematic revision of the genera of two important suborders, the Orthoidea and Pentameroidea. For a generation Schuchert has been the dean of American students of the Brachiopoda.

His interest in historical geology began in the study of stratigraphy, particularly of the Silurian and Devonian formations about Albany, while he was with Hall. It broadened and deepened immensely after he came to Yale and led to the publication, in 1915, of his well-known "Textbook of Historical Geology," which has since gone through four editions and has served in the training of countless students of the subject.

Professor Schuchert's most enduring fame will probably lie in the field of paleogeography. This was a new and little-explored field when he came to Yale and began teaching stratigraphy. He soon discovered that maps showing the distribution of ancient seas and lands greatly facilitated the interpretation of the stratigraphic record, and so he set about gathering data to build up such a set of maps for North America. In 1910, after nearly five years of research, he published his first results, "Paleogeography of North America," a volume with fifty maps and supporting text. This work was scarcely off the press before he was at work revising the maps and increasing their number so that each would represent a smaller unit of time and would show, in greater detail than previous maps had ever done, the outlines of the ancient lands and seas. For the rest of his life rarely a week passed that he did not modify some of these maps as he devoured the voluminous stratigraphic literature seeking new data. These working maps were the basis for those used in the several editions of his "Historical Geology" and so widely copied or adapted by others. His last great work, "The Historical Geology of North America," was prepared as a supporting text giving the basis for his final set of paleogeographic maps. The first of three large volumes of this work was published in 1935, the second in 1943, and the third was complete in typescript when he died, and, along with the maps, will be published posthumously. As the foremost exponent of paleogeography, he has left a distinct impress on the geologic literature of our times.

To his many graduate students Professor Schuchert was a foster-father and a friend, stimulating, encouraging and inspiring, both by his spoken word and by living example. He had learned the hard way, and he instilled in others a respect for hard work and a devotion to high ideals.

He was a member of many learned societies and the recipient of the highest honors his science could bestow. He was a member of the American Philosophical Society, of the National Academy of Sciences and of the Academy of Natural Sciences of Philadelphia; a fellow of the Geological Society of America and of the Paleontological Society; honorary member of the American Association of Petroleum Geologists; and a member or fellow of more than a dozen foreign societies. In 1929 he received the Hayden Gold Medal of the Academy of Natural Sciences at Philadelphia, and in 1934 he was awarded the Thompson Gold Medal of the National Academy of Sciences and the Penrose Gold Medal of the Geological Society of America. But perhaps the crowning achievement for one whom early adversity had denied so much as a high-school education, was to receive honorary degrees from New York University and Yale and Harvard.

CARL O. DUNBAR

RECENT DEATHS

ARTHUR LIVINGSTONE KIMBALL, research physicist and consulting engineer for the General Electric Company, Schenectady, N. Y., died on March 20 at the age of fifty-seven years.

DR. TRACY ELLIOT HAZEN, associate professor of botany, retired, at Barnard College, Columbia University, died on March 16 in his sixty-ninth year.

CHRISTIAN H. STOELTING, president of C. H. Stoelting and Company, Chicago, a former president of the Scientific Apparatus Makers of America, died on March 18 at the age of seventy-eight years.

THE death in his sixty-sixth year is announced on March 22 of Dr. Harry Lôuis Dember, visiting professor of physics at Rutgers University, formerly professor of physics and dean of the department of mathematics and physics at the Polytechnicum at Dresden.

THE *Journal* of the American Medical Association reports that special memorial services were held recently in Amasa Stone Chapel of Western Reserve University, Cleveland, for Dr. George W. Crile, who died on January 7. The speakers included Brigadier General Fred W. Rankin, Lexington, Ky., M.C., U. S. Army, president of the American Medical Association; Dr. Irvin Abell, Louisville, Ky., president of the American College of Surgeons; Dr. William E. Wickenden, president of the Case School of Applied Science and a director of the Cleveland Clinic Foundation, of which Dr. Crile was a co-founder, and Dr. Winfred G. Leutner, president of Western Reserve University.

SCIENTIFIC EVENTS

A NEW SEISMOGRAPH IN MEXICO

THE Mexican Ambassador to the United States of America announces that the State Government of Puebla, Mexico, headed by Dr. Gonzalo Bautista, has acquired an excellent Benioff vertical-component seismograph, to be installed at the National Astrophysical Observatory at Tonantzintla, State of Puebla. This instrument is now *en route* to Mexico.

The purchase of this modern seismograph was made from the National Research Council of Washington, D. C., through Dr. Harlow Shapley, director of the Harvard College Observatory, who made the necessary arrangements, in which the State Government of Puebla was represented by the Mexican Embassy in Washington.

The new seismograph is identical with the one installed in the Harvard Seismological Station; it is of the latest model available and is a valuable addition to scientific investigation in Mexico, since in the future the slightest microseisms will be recorded with absolute precision from Tonantzintla.

The close collaboration between the investigators of both countries is further strengthened by this purchase, and constitutes new evidence of the friendly ties uniting the peoples and the Governments of Mexico and the United States of America.

THE REPUBLICATION OF TECHNICAL BOOKS OF AXIS ORIGIN[1]

LEO T. CROWLEY, Alien Property Custodian, announced on March 24 that four hundred titles of individual technical books and sets of books of Axis origin are available for republication in furtherance of the war effort. Their titles were suggested by leading American scientists and librarians. Included among the titles are volumes on aviation, medicine, gas warfare, oceanography, physics, chemistry and other technical subjects.

Copyright interests in these works will be vested in the custodian for the purpose of having them republished as an aid to scientific research allied with the war effort. The custodian will seek reproduction and distribution of such works through normal pub-

[1] Statement received from the Office of War Information.

lishing channels by American publishers under licenses to be granted on May 1.

To encourage immediate republication and assure the widest possible use of scientific works, licenses will be granted on a non-exclusive basis for a five-year period. They will be royalty-free until all original costs incidental to republication have been recovered and then will bear a royalty of 15 per cent. of the list price of the works.

Licenses for republication will be granted to the publisher making the books available to the public in the shortest period of time and at the lowest list price. Information pertaining to requests for publication of each title will be made available to the publisher licensed to reproduce each work.

In many cases books with a very limited market are nevertheless of the greatest value in certain technical fields. In order to insure the most complete opportunity for prompt exploitation of the works after a license has been granted, no further license will be granted for a period of six months. Under similar licenses many sets of war-urgent scientific works aggregating approximately two hundred and fifty volumes are now being published.

It is hoped that the exploratory work done by the custodian will be of material assistance in securing immediate republication of those works most essential in the war effort. The exploratory work will be continued for such time as it may be of assistance in obtaining reproduction of such works. Copies of the listings of works are available at the Office of the Alien Property Custodian, Washington, together with a detailed statement of the policy which will be followed.

RARE CHEMICALS

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.:

1. Sodium Saccharate
2. 4-methoxy-2-butanone
3. p-amino phenyl stibonate of sodium
4. Avelina Rosada (So. American drug)
5. Solanocapsine
6. Solanocapsidine
7. Alpha chloro butyric acid
8. Chloro pentonoic acid
9. Sodium Iodoacetate
10. 2-amino-heptane sulfate
11. Disodium phenyl phosphate
12. Gallium
13. Rubidium
14. Cesium
15. b-hydroxy glutamic acid
16. Alcohols or mercaptans of the aliphatic series having 20 or more carbons in the molecule

THE SOCIETY OF THE SIGMA XI

DR. HARLOW SHAPLEY, director of the Harvard College Observatory, president of the American Association of Arts and Sciences, has been elected president of the Society of the Sigma Xi, the national honorary society for the promotion of research in science.

Dr. C. Frederick Hansen, vice-president and trustee of the Grant Foundation, director of research and planning of the W. T. Grant Company, has been elected a member of the Alumni Committee for a period of five years.

Dr. Carleton C. Murdock, professor of physics at Cornell University, has been named a member of the executive committee for the same term.

The other officers of the society are:

Dr. George A. Baitsell, of Yale University, *Secretary;* Dr. George B. Pegram, of Columbia University, *Treasurer;* Dr. Carl D. Anderson, California Institute of Technology; Dr. Harvey E. Jordan, University of Virginia; Colonel C. E. Davies, American Society of Mechanical Engineers; Dr. Fernandus Payne, Indiana University; Dean Edward Ellery, Union University, all members of the *Executive Committee;* and Dr. James R. Angell, National Broadcasting Company; John C. Parker, vice-president, Consolidated Edison Company of New York; Dr. A. Elizabeth Adams, Mt. Holyoke College, and Dr. Paul R. Heyl, National Bureau of Standards, all members of the *Alumni Committee.*

A new chapter was installed at the Polytechnic Institute of Brooklyn on March 25, with Dr. Shapley and Dr. Baitsell as the installing officers. Dr. Saul Dushman, assistant director of the Research Laboratories of General Electric Company, spoke at the dinner in the evening.

A new Sigma Xi chapter at Tufts College at Medford, Mass., was installed on April 2. After a convocation in the morning and formal installation ceremonies in the afternoon, there was a dinner, followed by the installation address on "The Mathematical Nature of Modern Physical Theories," by Dr. George David Birkhoff, Perkins professor of mathematics, Harvard University.

The Radcliffe College Chapter will be formally installed on Thursday, April 15. The installation address will be made by Dr. S. Gaposchkin, of the department of astronomy, Harvard University.

Sigma Xi was founded in 1886 at Cornell University by a small group of graduates in science. Only those who have carried on original and independent investigation are eligible to membership.

Sigma Xi is now established in one hundred and twenty-five principal universities and cities throughout the country. This organization includes in its membership a large percentage of the scientific workers in all branches of natural science. The total mem-

bership is now about 50,000. Chapters elect 3,200 members and associates annually from faculties, graduate and undergraduate bodies. Sigma Xi promotes research through grants, national lectureships and publications. It publishes the quarterly, *The American Scientist*.

ISAIAH BOWMAN, PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE newly elected president of the American Association for the Advancement of Science has had such important contacts with so many branches of the natural and the social sciences that any biographical sketch or introduction seems quite unnecessary. I shall, therefore, confine my remarks to a few comments which may give a more intimate picture of the character and personality of our new president.

In the depths of the early depression, the National Research Council felt the need of a strong guiding hand to steer it through financial shoals and at the same time to increase its usefulness in this time of urgent need. After careful survey of possibilities, it elected Isaiah Bowman to this post in 1933. The council immediately took on a new lease of vigorous life. At about the same time, the Federal Government was faced with the necessity of drastic curtailment of expenses, including those of its scientific bureaus. How, in spite of this, could the effectiveness of these bureaus be maintained and, if possible, increased? To this end the Science Advisory Board was invented by Isaiah Bowman and appointed by President Roosevelt. The only reason why Bowman was vice-chairman rather than chairman of this board was his own modesty in not wanting to take the headship of an organization which he himself had promoted. Though there was disappointment in failure to secure action on some of this board's important recommendations, approximately two thirds of its recommendations were put into effect and even its failures left a useful background of education of many governmental officials.

Again in this difficult period, the Johns Hopkins University sought a new head. Here again financial problems were insistent and discouraging. Furthermore, a long period of temporary administration had accumulated an unusually large number of problems to await solution by the new administration. Several years of painstaking search resulted in Isaiah Bowman's selection as the new president.

Now, in the midst of our greatest war, when travel restrictions even curtail or prevent its annual meetings, and when new problems and difficulties are encountered on every hand, the American Association for the Advancement of Science elects Isaiah Bowman to be its president.

One's first reaction to this recital might well be: "What a bear he is for punishment!" To this I subscribe, with the comment that, like the early Christian martyrs, he suffers in a good cause. Unlike them, he seems to survive. Unlike them also, he seems to enjoy it. The real answer is not that he likes punishment, but that he is ever eager to throw his tremendous energies and abilities into any importantly constructive job which needs to be done as a public service, especially when this job involves the better utilization of science and the scientific method. He reacts quickly and vigorously, and always constructively, to a challenge.

Professionally, Isaiah Bowman is a geographer, but not in the limited sense of the little girl's definition of geography as "the study that tells us what's where." It is more in the sense of that verse in the Princeton Faculty song which runs: "He tells us how the world was made, and where the Lord the sidewalks laid." Isaiah Bowman's geography includes, in a vital way, the whole gamut of natural and social science—everything in fact which affects man's life on this planet; meteorology, climatology, oceanography, transportation, engineering, soil science, anthropology, geology, biology, political economy and many other specialized fields are, to him, aspects of the great science of man's life in his environment. It is hard to conceive of any other scientific background which would so well fit a man to head a great, diverse scientific body like the American Association for the Advancement of Science.

I recall Bowman's description of his experiences as member of both the National Research Council and the Social Science Research Council. He described the meetings of the latter council as full of interest, brilliant wit and repartee by members with rich backgrounds of cultural interest. The discussions wandered far and wide from the subject at issue and the actual business transacted was slim, but the meetings were thoroughly enjoyable. In the National Research Council, on the contrary, there were no frills; business was transacted in one, two, three order with cold efficiency, and the meeting adjourned. Bowman found satisfactions, and also some defects, in both performances.

The twenty most important years of Isaiah Bowman's career as a professional geographer were 1915 to 1935 while [illegible]ctor of the American Geographical Soc[illegible]York, though before this, while on the fa[illegible]le University, he headed productive researc[illegible]ions in Peru and the Central Andes general[illegible]

I refer the reader to "Who's Who in America" or to "American Men of Science" for the details of some dozen honorary degrees, some six medals (four specified as golden!) from learned societies of five nations, and membership in more national and international scientific bodies than I could count twice with the

same answer. Of particular note is his membership on such important commissions as those attached to the Peace Conference in Paris; the Red River Boundary Dispute; the Permanent International Commission, China and the United States. His publications are many and significant; their scope is suggested by such titles as Forest Physiography; The Andes of Southern Peru; The New World—Problems in Political Geography; Desert Trails of Atacama; The Mohammedan World; The Pioneer Fringe; Design for Scholarship; and so forth, plus a very large number of articles in scientific journals.

Amid all these activities and accomplishments, I suspect that, in the rare times when he can think his own thoughts about his own secret desires, these thoughts often turn to the little island on Lake Wentworth in New Hampshire where the Bowman family have had their summer camp in true woods-lover's style. Here the talented and attractive family, Isaiah and Cora Bowman and their two sons and a daughter, have come especially close to each other and to the renewing strength of Mother Nature. Here, too, a small rustic isolated shack used as a study has been the scene of high-pressure writing as well as of reading and contemplation. Perhaps the newly elected president of the American Association for the Advancement of Science may have the privilege of writing his presidential address in this safe retreat, if gas and tires hold out.

Those who have been associated with Isaiah Bowman on various assignments are unanimous, I believe, in feeling that they could ask for no better team-mate. In this spirit he is welcomed by old and new associates as he undertakes the new term of leadership of the American Association for the Advancement of Science.

KARL T. COMPTON

SCIENTIFIC NOTES AND NEWS

DR. IRVING LANGMUIR, associate director of the General Electric Research Laboratory, Schenectady, has been elected to honorary membership in the Institute of Metals, London. There are two honorary members of the institute—Professor C. A. F. Benedicks, director of the Metallographic Institute, Stockholm, and Dr. A. M. Portevin, who was professor of metallurgy in the Central School of Arts and Manufactures in Paris before the German occupation. Among past honorary members, now dead, were Sir William Crookes, Sir J. J. Thomson, Lord Rutherford, Professor G. Tammann and Sir William Bragg.

THE University of California at Berkeley has conferred an honorary degree on Dr. Samuel J. Holmes, professor of zoology, emeritus.

THE University of Santo Domingo has conferred an honorary degree on Dr. Hugh S. Cumming, director of sanitation of the Pan American Union.

A FRANKLIN MEDAL of the Franklin Institute, Philadelphia, was presented at the annual medal day ceremonies at the institute on April 1, to Dr. George Washington Pierce, Rumford professor of physics, later Gordon McKay professor of communication engineering at Harvard Univ[illegible] recognition of his outstanding inventions, his [illegible]ical and experimental contributions in the field of electric communication and his inspiring influence as a great teacher." The medal was also awarded to Dr. Harold Clayton Urey, professor of chemistry at Columbia University, in recognition of "his discovery of an isotope of hydrogen of mass 2, which has resulted in the opening of new fields of knowledge."

Chemical and Engineering News announces that Raymond R. Ridgway, associate director of research at the Norton Company, Niagara Falls, has been selected Jacob F. Schoellkopf Medalist for 1943. This medal is awarded annually by the Western New York Section of the American Chemical Society "for distinguished research or chemical achievements by chemists of the Niagara Frontier." The medal will be presented at the May meeting of the section at which time Mr. Ridgway will give the medalist's address.

THE Hillebrand Prize of the Chemical Society of Washington for 1942 was presented on March 11 to Dr. John Frank Schairer, of the Geophysical Laboratory of the Carnegie Institution of Washington. The award is made in recognition of his work on the phase relations in multi-component silicate systems and in particular for his work on the four-component system $CaO—FeO—Al_2O_3—SiO_2$. This award is named for William Francis Hillebrand, formerly chief chemist of the National Bureau of Standards.

THE Electrochemical Society has awarded the Young Author Prize for 1942 to Dr. Sidney Speil, associate non-metals engineer of the Government Electrotechnical Laboratory at Norris, Tenn. Accompanying a cash prize is a certificate for scientific and technical books to the amount of $50. This book prize was established a year ago by Francis Mills Turner, of New York.

DR. A. L. TATUM, professor of pharmacology at the Medical School of the University of Wisconsin, is the recipient of the Charles Mickle Fellowship for 1942 of the University of Toronto in recognition of his work in the study of cocaine poisoning and its treatment, morphine addiction, the use of picrotoxin as

an antidote to barbiturate poisoning and his introduction of mapharsen for the treatment of syphilis. The fellowship is in the nature of an award, being the annual income from an endowment of $25,000.

The Committee of the Athenaeum, London, according to *The Times,* London, has elected the following under the provisions of Rule II, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature or the arts or for their public services: Sir William Stanier, scientific adviser to the Minister of Production; Sir Thomas Lewis, director of clinical research, University College Hospital; Sir Bernard Pares, lately professor of Russian history, University of London.

Dr. Henry E. Crampton, professor of zoology at Barnard College, Columbia University, will retire at the close of the present academic year.

The title of professor emeritus of botany of the University of London has been conferred on Dr. R. Ruggles Gates on his retirement at the age of sixty years. Dr. Gates is now working at the Marine Biological Laboratory at Woods Hole.

Dr. L. S. Palmer, professor of agricultural biochemistry at the University of Minnesota, has been named chief of the Division of Agricultural Biochemistry.

D. C. Tingey, associate professor of agronomy of the Utah State Agricultural College and Experiment Station, has been given leave of absence to become senior agronomist of the Bureau of Plant Industry of the U. S. Department of Agriculture in the guayule production project in California and Southwestern States.

Dr. L. Grant Hector, who has been engaged in electronic development work for the Office of Scientific Research and Development of the U. S. Government, has joined the staff of the National Union Radio Corporation of Newark, N. J., and Lansdale, Pa. He will direct electronic tube research and engineering activities.

Dr. A. F. Camp, horticulturist in charge of the Citrus Experiment Station, Lake Alfred, Fla., has returned recently from Argentina and Brazil, where he spent several weeks as consultant for the citrus industry there. This trip, arranged through the different state departments, was requested by the citrus growers of the countries concerned.

John S. Karling, professor of botany at Columbia University and formerly director of the chicle research work of the Tropical Plant Research Foundation, according to *Museum News,* is on leave of absence for the duration of the war to work as a botanical specialist in the latex-bearing plants of the Department of Rubber Exploration of the American Republics Aviation. He will be associated with G. H. H. Tate, formerly of the American Museum of Natural History, in exploring the little known tributaries of the Tapajoz and Madeira Rivers in Brazil for sources of wild rubber.

Dr. Luther S. West, for five years head of the Division of Natural Science of the Northern Michigan College of Education, Marquette, has been granted leave of absence to accept a commission with the rank of captain as entomologist in the Department of the Surgeon General.

Dr. Joseph B. Goldsmith, associate professor of histology and embryology at the School of Medicine of the University of Oklahoma, has leave of absence to become First Lieutenant in the Sanitary Corps of the Army.

Dr. Paul R. Heyl, of the National Bureau of Standards, retired, gave a lecture on March 27 before the Philosophical Society of Washington. The lecture was entitled "The Genealogical Tree of Modern Science."

Dr. O. H. Robertson, professor of medicine at the School of Medicine, University of Chicago, will deliver the seventh Harvey Society Lecture of the current series at the New York Academy of Medicine on April 15. He will speak on the "Sterilization of Air with Glycol Vapors."

Dr. Frank C. Mann, professor of pathology, experimental physiology and surgery of the University of Minnesota Graduate School at Rochester, delivered on March 12 the Alpha Omega Alpha lecture of the Institute of Pathology at Cleveland. He spoke on "The Value of Research in Medical Education."

Dr. Vincent du Vigneaud, head of the department of biochemistry at Cornell University Medical College, addressed the Central Pennsylvania Section of the American Chemical Society on March 16 on "Transmethylation as a Metabolic Process." It was emphasized that transmethylation is the first new principle introduced into the science of nutrition since the discovery of the vitamins.

Dr. W. M. Stanley, of the Department of Animal and Plant Pathology of the Rockefeller Institute for Medical Research, addressed on March 2 the Chapter of Sigma Xi at Massachusetts State College. His subject was "Virus Diseases of Plants and Animals." On the following day he spoke at a Sigma Xi luncheon at Smith College on "Recent Developments in Virus Study."

David Dietz, science editor of the Scripps-Howard Newspapers, gave two lectures before the Council on

World Affairs in Cleveland, Ohio, speaking on February 24 on "Science and the War" and on March 3 on "Science and Post-war Reconstruction."

THE American Association of Cereal Chemists has for the second successive year chosen one of its members who has done notable work in the field of cereal chemistry to lecture on the research work in which he has been engaged before a number of the sections of the society. This year the lecturer will be Dr. John C. Baker, chief chemist of Wallace and Tiernan Company, Inc., of Newark, N. J., who has done distinguished work in the field of wheat proteins. The subject of his lecture will be "Gluten and its Relation to Flour Constituents in Bread Making." Dr. Baker is lecturing at Columbus, Ohio; Ft. Worth, Texas; Manhattan, Kans.; Winnipeg, Canada; Minneapolis, and Chicago.

PROFESSOR WILMON HENRY SHELDON, of the department of philosophy of Yale University, is delivering, beginning on April 1, the first series of Woodbridge lectures in philosophy at Columbia University. The general subject of the series is "Process and Polarity." The lectures were established in memory of Dr. Frederick J. E. Woodbridge, Johnsonian professor of philosophy at Columbia University and dean of the Graduate Faculties from 1912 to 1929. Professor Woodbridge died in 1940.

THE thirty-eighth annual meeting of the American Association of Museums, which would normally be called for this spring, will not be held in 1943 owing to the need for curtailment of travel.

THE thirty-fifth annual meeting of the American Society for Clinical Investigation, scheduled to take place on May 3 at Atlantic City, has been cancelled.

THE forty-eighth annual meeting of the Michigan Academy of Science, Arts and Letters was held in Ann Arbor on March 26 and 27.

THE Section of Physics and Chemistry of the New York Academy of Sciences will sponsor a conference on sulfonamide to be held on April 16 and 17 at the American Museum of Natural History.

THE name of the State School of Mines at Rapid City, S. Dak., has been changed to the South Dakota School of Mines and Technology.

ANNOUNCEMENT is made of the formation of a department of nutrition in the ministry of public health of the Republic of Paraguay. The unit was formed under the direction of Dr. Francisco A. Montaldo, who for two years specialized in the study of nutrition at the Institute of Nutrition at Buenos Aires on a scholarship provided by the government.

AN Emergency Food Commission "to foresee and meet situations as they arise" has been appointed by Governor Dewey of New York State. The objects of the commission are (1) to help New York farmers to attain maximum production, partly through alleviating such shortages as those in labor and machinery; (2) to assure continued shipment into the State of necessary feed and other supplies; (3) to guide adaptation of New York citizens "with foresight and common sense" to necessary changes of diet. The chairman of the commission is H. E. Babcock, of Ithaca, chairman of the Board of Trustees of Cornell University, a former president of the Grange League Federation Exchange. Dean Carl E. Ladd, of the College of Agriculture at Cornell University, is executive director. Among members of the commission is Dr. L. A. Maynard, director of the Cornell University School of Nutrition.

A GIFT from Archer M. Huntington to the state of New York of 500 acres of land, including High Tor, has been announced by Edmund W. Wakelee, president of the Palisades Interstate Park Commission. It is planned to convert the property into a bird sanctuary. The land includes the northernmost point of the Palisades and is on one of the principal migratory-bird routes of the East. It is favored as a breeding ground by several species of rare birds, including the swift duck-hawk.

THE Committee on Pharmaceutical Research of the American Pharmaceutical Association announces the availability of certain limited funds for research grants. These grants are to be made by the council of the association on the recommendations of the committee. They are to be made on the following basis: (a) the extent which the award will serve to promote pharmaceutical research; (b) whether the award supplements the laboratory program of the association; (c) the qualifications of those who will perform the work for which the award is made and the facilities of the laboratory where the research will be conducted; (d) preference will be given to applications wherein the award will supplement a contribution from the institution or laboratory in which the research will be conducted. Those interested in being considered for the above awards will please communicate with the chairman of the Committee on Pharmaceutical Research (Francis E. Bibbins, 150 West 64th Street, Indianapolis, Indiana) who will send an application blank which, when returned, will supply all the details that will enable the committee carefully to evaluate the projects listed in the application. These applications should be forwarded promptly so that they can be given early consideration.

DISCUSSION

A REPLY TO PROFESSOR WILLEM J. LUYTEN

As a college administrator, without scientific training, I would not presume to write to SCIENCE about a scientific review of a book or a discussion based upon such a review. Criticism of scientific research and text-books is valuable. It helps to correct errors; it alters false emphases; it serves to avoid misinterpretation. Without free and frank criticism it would be difficult to maintain freedom of thought, speech and research in academic circles.

Only a scientist should answer a scientist. But there is very little science in Professor Luyten's discussion and it is not inappropriate for a layman (so far as science is concerned) to reply to misquotation, misunderstanding, ignorance, innuendo and malice.

If Professor Luyten had confined himself to precise criticism of fact, as in his reference to determination of latitude by angular distance of sun or star, he would have been helpful. This is either so or it isn't. If so, Mr. Bauer will make the correction.

Professor Luyten makes factual criticism of statements referring to (1) the exact distance from the South Pole of the nearest point on the great circle route from Buenos Aires to Melbourne; (2) whether the correction of the variation of the North Star from the celestial pole can properly be termed "small"; (3) the exact date of the equinoxes; (4) the exact rotational speed of the surface of the earth at Hammerfest. These are points of fact to be weighed in the balance by the value of precise statement on the one hand as contrasted with general statements on the other in their importance as complicating or facilitating the ease of teaching. Certainly one "howler," if established, by itself does not condemn a book or series of books.

When he comes to a discussion of Renner's "The Air We Live In" (incorrectly referred to as "The Air-Age We Live In"), Professor Luyten enters the area of misquotation and misunderstanding. Professor Luyten would have the reader believe that Renner had taken the position that "the earth is not 8,000 miles but really 50,000 miles in diameter, the atmosphere ends at 21,000 miles above the solid surface because gravitation stops abruptly at that point. Oxygen and nitrogen cease to exist at altitudes higher than 80 miles, above which one finds only hydrogen and helium. At the top of the atmosphere the particles of air may be many feet apart, perhaps even miles, and the temperature up there is the same as that of interplanetary space—absolute zero. If a man were hauled up to the top of the atmosphere he would explode."

What Renner actually wrote was: "Theoretically, the atmosphere could be 21,000 miles deep because the earth's gravitation has the power to hold captive the tiny particles of air out to that distance. Whether extremely rarefied air actually does extend out to 21,000 miles, we probably shall never know. All we know at present is that the atmosphere is at least 300 miles deep with every evidence pointing to a . . . considerable distance beyond that. . . . The air simply thins out to unbelievable rarefaction." With regard to the oxygen and nitrogen "ceasing to exist," the book merely says: "The lower atmosphere may contain more heavy gases such as argon, and the upper atmosphere may contain more of the light helium. We are, as yet, not sure whether this is true or not."

Professor Renner when confronted with the criticism with regard to the temperature of the outer edge of the atmosphere, made the following statement to me: "Temperature is the measure of heat level; heat is the energy of molecular motion; out at the edge of the atmosphere, beyond the upper warm zone of rarefied gases, where there are practically no molecules of matter, it is reasonable to think that there is practically no heat. Indeed, according to H. Spencer Jones, the British Royal Astronomer, 'the black body temperature of space is only about 3° absolute.'" Whatever the facts may be, they can hardly warrant Professor Luyten's unjust conclusion that "the authors of this elementary school text do not understand the principles of the physical universe."

Professor Luyten further states that Renner-Bauer "appear to confuse the average distance apart between particles with the mean free path, and when they give the pressure exerted by the ocean on a fish at a depth of five miles as 11,458 pounds per square inch, the 8 may be correct but the 4 is certainly wrong." It is difficult to give a straightforward answer to vague innuendo of this type. The figure 11,458 was arrived at by multiplying the height of a column of water of five miles by weight per unit of volume, plus the weight of atmospheric pressure. This is merely a matter of arithmetic. It is indisputable that if a deep-sea fish is hauled quickly to the surface, it explodes. Whether the analogy is happy or not, it would seem to be indisputable that if a man were hauled rapidly up out of his atmosphere, his capillaries would rupture or explode (Latin: *explodere*—to push out) and death from bleeding would doubtless result even if he could be supplied with oxygen.

Coming to the book Professor Luyten referred to as "Human Geography and the Air Age" by Renner (correct title "Human Geography in the Air Age"), we reach a stage in the discussion which is unworthy

of a true scientist. Professor Luyten does not confine himself to the book which he is discussing. He goes out of bounds both intellectually and in matters of good taste. He refers to the author as a "great self-confessed genius" and makes it appear that "amateurs in the State Departments" is a quotation from the book in question. I have never heard Professor Renner confess himself a genius and the quotation does not appear in the book referred to. No mention is made in the book of ending all future troubles in the Balkans by giving Italy the entire Dalmatian coast. Nor is there any reference to massacres in Jugo-Slavia. Professor Renner claims to be a geographer. I know of no claim made by him as "economist, historian, political scientist, linguist and transportation expert" except that which would be made by any educated and cultured gentleman like Professor Renner. There is no statement in the book that "the British built the Suez Canal." It does state on page 18: "The British performed some continental surgery and made a bottleneck at Suez" which a fair-minded man could see might refer to the recent reconstruction of the Canal and the construction of the naval base at Alexandria.

Professor Luyten states that "to find a person who claims to be a geographer, economist, . . . stating that the Rhine Valley lies in Austria is quite a record." A good record, I should think; for the Rhine forms the border between old Austria and Switzerland for many miles.

Professor Luyten continues his departure from science and uses the method of innuendo when he states that Professor Renner "speaks feelingly about illiteracy when referring to people who do not agree with him." I find nowhere in the book that the author calls any one illiterate and certainly not because of disagreement with him. He does include a statement regarding geographical illiteracy in a quotation from the United States Commissioner of Education.

One other example of the unscientific and unfair quality of the discussion of Professor Willem Luyten is his reference to Professor Renner as "Herr Doktor." This is malicious. Professor Renner's ancestors fought in the American Revolution and he is listed in the first families of New York. Such a statement might be made in a smear campaign. It has no place in a scientific discussion.

Professor Luyten further states that the book makes reference to the General Staff as composed of "admirals, generals and similar elderly people." I can find no such statement. It does not represent Professor Renner as I know him. Indeed, I have seen a letter to Professor Renner from an Army general on the General Staff which reads: "I have completed your splendid book, 'Human Geography in the Air Age,' and want to congratulate you. I am personally urging my officers to secure copies of the book." I am able further to state that the relations between Professor Renner and the Army and the General Staff have been more cordial than Professor Luyten may suspect.

As I read the book I can find nothing that gives the impression of superiority, criticism or tragedy which Professor Luyten seems to have received from it. By means of this low form of criticism, Professor Luyten seeks to implant in the reader the suspicion that Professor Renner is anti-British, using such statements as "hated British." Quite in contrast to this, the book actually refers to "our relatives, the British." Out of whole cloth Professor Luyten invents the statement: "Mr. Renner is wont to complain about the fact that the British control all but one of the bottlenecks between oceans." What the author does say is: "Britain not only held these ocean gateways, but developed an immense navy to enforce complete control over them. This was the famous 'Pax Britannia' which gave freedom of the seas to the world for over a hundred years." No reasonable person could find any complaining in that statement.

Another malevolent statement by Professor Luyten is as follows: "The real tragedy lies in that these books come dressed up with copious references to the Civil Aeronautics Administration which will be mistaken by many still less-informed people as indication of approval by the C.A.A." This is only one additional blow below the belt struck by Professor Luyten in order to create a doubt in the mind of the reader. It seems to me that he implies that Dr. Wood, being a professor of psychology, is unfitted to participate in a project preparing books on aviation education in elementary and secondary schools; that the books were written without the cooperation of the Civil Aeronautics Administration; that the authors are "uninformed"; that the books are not yet in use "but that if they should be adopted in many schools" it would be unfortunate. The facts are: Dr. Wood is Professor of Collegiate Educational Research in Columbia University (unfortunately for us, not in Teachers College) and long a student of public school problems; the entire twenty books were based on research projects initiated and partially financed by the Civil Aeronautics Administration; (the books plainly state that they were prepared with the cooperation of the Civil Aeronautics Administration); the authors were selected because of special competence; and, as for the possibility of the books being adopted for use in schools, nearly a half million of them have been in use for some time and they are being called for as fast as they can be printed.

As a matter of general interest, it may be stated

here that the entire series was produced as a war emergency measure at the urgent request of a prominent government official. The authors' expenses were paid, but these authors waived all royalty rights in the interest of the war effort. The Macmillan Company cooperated by publishing and distributing the books at phenomenally low prices. Teachers College added its contribution by donating the time of staff members, contributing library service and space, workshop and laboratory quarters, and by carrying the cost of conducting courses in Aviation Education. The books were written in ninety days and published in slightly less than sixty days—five months in all—in order to meet the government's deadline. Prices run from 15 cents to 99 cents for sizable cloth-bound volumes. This breaks all previous records for book production and also for hard work. It was necessary, however, in order to meet the war emergency. The emergency was met and the results have been greater even than anticipated. Education can well be proud of the whole accomplishment. To attempt to smear such an effort can serve no good purpose.

It is to be expected that errors will be found. It is proper and useful that scholars should point them out. Professor Renner, and the other authors of the Air-Age Education Series will correct in future editions mistakes of fact, emphasis or taste. Discussion is welcome; but this does not mean that worthy, industrious, patriotic and informed workers should be subjected to malice and abuse.

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SCIENTIFIC BOOKS

ELECTROPHORESIS OF PROTEINS

Electrophoresis of Proteins and the Chemistry of the Cell Surfaces. By Harold A. Abramson, Lawrence S. Moyer and Manuel H. Gorin. 328 pp. Reinhold Publishing Corporation. 1942. $6.

Although the discovery of the electrophoresis of protein-coated particles was made as early as the beginning of the nineteenth century, the application of this important method to the study of proteins was limited owing to its lack of resolving power. Recently, Arne Tiselius introduced great improvements in electrophoretic methods using the moving boundary technique. The most important contribution of his method lies in its ability to resolve a soluble mixture of proteins into separate components. In this way, one or more biologically active protein fractions can be identified, and in many cases, it is possible to isolate them as electrically homogeneous individuals. A well-known example is the identification and isolation of antibody as the gamma globulin fraction in the sera of immune animals. More recently, Longsworth has added other important improvements which further increase the resolving power. During the past few years, many biologically active proteins have been examined by electrophoretic analysis with the moving boundary method to determine electrochemical homogeneity and to obtain information which might facilitate chemical isolation. In fact, the method has become one of the powerful tools in many fields of research.

Therefore, there is a timely need for a book on the electrophoresis of proteins. Abramson, Moyer and Gorin have written such a book with the aim of fitting "the needs of investigators in diverse fields, such as biology, chemistry, medicine and physics."

The text may be divided into four parts, the first of which comprises a brief historical background together with an elementary but adequate presentation of the general principles of electrophoretic migration in liquids. It also includes two chapters (5 and 6) dealing with more theoretical discussion which, however, is inconsequential to biologists interested in using electrophoresis as a tool. These chapters are included apparently for physical chemists. In the second part, both the microscopic method and the moving boundary method are described in great detail. The third section of the book deals essentially with the results of electrophoretic studies on proteins and other colloidal substances. Although the list of proteins examined is rather complete, the authors make no distinction in the text as to which of the above-mentioned methods has been employed. The remaining part of the book (Chapter 14) deals briefly with the "Surface Chemistry of Cells."

It is obvious that in a small volume of three hundred and twenty-eight pages, all these topics can not be treated very critically and precisely. This will not be wholly to the liking of the investigators in specialized fields. A few examples may be mentioned. The phrase "follicle stimulation in the male" (p. 274), would be rejected by endocrinologists as meaningless. The lack of clarification of the terms, "iso-ionic point" and "iso-electric point," would meet the disapproval of physical chemists. The omission of important chemical aspects in the discussion of "Antigen, Antibody, and Their Reactions" (Chapter 8) would be questioned by immunologists. To these criticisms, one might add that there are numerous errors in composition and printing. For example, in the text of page 69 a description of the optical arrangement of Svensson is referred to "28a," which actually is an

electrophoretic pattern of normal human plasma. Svensson's arrangement is apparently missing in the book.

In spite of such errors and oversights, Abramson, Moyer and Gorin's book on the electrophoresis of proteins represents a compilation of data on the electrophoretic analysis of proteins useful to all investigators of proteins.

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CHEMISTRY OF DENTAL MATERIALS

Outline of the Chemistry of Dental Materials. By LAURENCE G. WESSON, research biochemist, Forsyth Dental Infirmary for Children, Boston, Massachusetts. 106 pp. 5×7.5. St. Louis: The C. V. Mosby Company. 1942. $1.50.

THIS book contains a concise review of some of the properties and uses of materials employed in dental practice. The chemical changes which many of these materials undergo and their effects on the oral tissues are clearly, although briefly, described. Such topics as the chemistry of vulcanization, and the formation of polymethyl methacrylate resin, which is used as a substitute for vulcanite in artificial dentures, will be of interest to the dentist. The sections on dentifrices, dental cements, the action of ammoniacal silver solution and photography should prove of value.

The dental section of the book is preceded by an elementary review of some of the principles of chemistry. Although brief, this material should be helpful to the dental practitioner. The descriptions of such topics as the nitrogen cycle and the potential acidity and alkalinity of food, although of general interest, could well have been omitted in a book of this type.

This outline should also prove useful as a supplementary text in courses for dental hygienists.

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SPECIAL ARTICLES

THE EFFECT OF TRYPTOPHANE DEFICIENCY ON REPRODUCTION[1]

PREVIOUS reports from this and other laboratories[2-7] have shown that tryptophane deficiency induces loss of weight, alopecia, cataract formation, corneal vascularization, defective dentition, testicular atrophy, hypoproteinemia and hypochromic anemia.[8] The present report describes observations we have made on the effect of a tryptophane deficient diet on the reproductive function in female rats.

Normal adult male and female rats from a hybrid albino and hooded Norwegian rat colony were maintained on stock diet and mated. As soon as vaginal smears showed the presence of sperm the females were segregated in individual cages and were fed a tryptophane deficient diet[7, 8] *ad libitum.* The data given in Table 1 show that all the rats on the deficient diet failed to cast a litter in contrast to a group of animals continued on the control diet all of which reproduced normally. The animals on the deficient diet were kept on it for 35 to 40 days. All of them lost weight and it was notable that symptoms of tryptophane deficiency developed earlier in these animals than in unmated rats on a tryptophane deficient diet. For example, alopecia, which in our experience is rarely evident before 60 days on the deficient diet, was very evident within 30 days in the present group of animals. Corneal vascularization was likewise well developed early in the deficiency period.

TABLE 1

THE EFFECT OF TRYPTOPHANE DEFICIENCY ON THE WEIGHT AND SIZE OF LITTER OF THE PREGNANT RAT

Group	Animal number	Initial body weight	Weight change for gestation period	Average daily food intake	Gestation period	Size of litter
		gms.	*gms.*	*gms.*	*days*	
Control	PCTH–3	201	+29	9.3	22	9
	PCTH–4	168	+43	7.6	23	6
	PCTH–5	209		7.7	22	7
	PCTH–6	221	+30	6.9	24	6
	PCTH–7	187	+41	9.2	22	8
	PCTH–8	208	+37	10.0	22	10
	PCTH–9	263	+27	10.0	22	10
	PCTH–10	232	+11	9.9	30	4
Deficient*	PTH–2	211	–40	9.1		0
	PTH–3	208	–13	8.0		0
	PTH–6	193	–63	8.0		0
	PTH–7	219	–24	7.6		0
	PTH–8	199	–29	8.9		0
	PTH–11	242	–43	6.9		0
	PTH–12	220	–40	7.0		0
	PTH–13	219	–22	9.7		0
	PTH–15	228	–35	9.6		0

* The weight change determined as of the 22nd day after insemination.

In order to determine the fate of the fetus in these deficient animals a second experiment was carried out similar to the above in which female litter-mates were

[1] This investigation was aided by grants from the Rockefeller Foundation, Merck and Company and E. R. Squibb and Sons.

[2] E. G. Willcock and F. G. Hopkins, *Jour. Physiol.*, 35: 88, 1906.

[3] E. Abderhalden, *Ztschr. Physiol. Chem.*, 83: 444, 1913.

[4] R. S. Alcock, *Physiol. Rev.*, 16: 1, 1936.

[5] P. B. Curtis, S. M. Hauge and H. R. Kraybill, *Jour. Nutr.*, 5: 503, 1932.

[6] J. R. Totter and P. L. Day, *Jour. Nutr.*, 24: 159, 1942.

[7] A. A. Albanese and W. H. Buschke, SCIENCE, 95: 584, 1942.

[8] A. A. Albanese, L. E. Holt, Jr., C. N. Kajdi and J. E. Frankston. *Jour. Biol. Chem.*, in press.

placed on the deficient diet after mating. These animals were then sacrificed on the 9th, 11th, 13th and 14th days after insemination, and the uteri examined. It was found that embryos of normal size and appearance were present on the 9th day, whereas by the 14th day almost complete resorption had occurred, the embryonic masses being then scarcely discernible. A similarly treated control animal sacrificed on the 14th day of gestation showed twelve normal sized embryos.

It would appear from the above experiments that tryptophane is a most important dietary essential for normal gestation and that the available stores of the adult female rat are depleted in the course of ten days of a tryptophane deficient regimen.

We have found no reports in the literature dealing with the effect of tryptophane deficiency on the female reproductive function. However, numerous studies are to be found[9] on the deleterious effects of low protein diets on the reproduction of farm animals, and Guilbert and Goss[10] have shown that feeding a low protein diet to female rats results in reproductive failure. In the light of our findings it is pertinent to raise the question whether these effects of a low protein diet may be attributed to a low tryptophane intake.

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INFLUENCE OF FEVER UPON THE ACTION OF 3,3′-METHYLENE-BIS-(4-HYDROXY-COUMARIN) (DICUMAROL)

FOLLOWING the isolation and synthesis of the anticoagulant Dicumarol (3,3′-methylene-bis-(4-hydroxy-coumarin) by K. P. Link and collaborators,[1,2] this drug has rapidly gained the attention of scientists and clinicians alike. Since this drug will frequently be used in conditions accompanied by fever, it appeared desirable to investigate the influence of higher body temperatures upon its action. It is well known that biochemical reactions are accelerated by increase in temperature, but the degree of this acceleration varies greatly from instance to instance, depending on the type, and may show unexplained abnormalities.[3]

Fever was induced in rats by the injection of a yeast suspension or typhoid vaccine which resulted in a marked rise of temperature 5 to 15 hours later. If necessary, a second injection was made. Twelve hours after the administration of the pyrogenic agent, the rats were fed 2.5 mg Dicumarol orally. Prothrombin time was determined in 12.5 per cent. plasma 24 hours after Dicumarol administration, using the method described by Link and associates.[4] In normal rats this dose of Dicumarol raises the prothrombin time from about 45 seconds to 1 minute, 47 seconds. Fever alone causes no or only a very slight increase in prothrombin time. However, animals having received Dicumarol during fever showed a tremendous increase of the prothrombin time as compared with the rats having a normal temperature.

TABLE 1

EFFECT OF 2.5 MG DICUMAROL IN RATS (PROTHROMBIN TIME OF 12.5 PER CENT. PLASMA 24 HOURS AFTER ADMINISTRATION)

	Group				
	A	B	C	D	E
Maximal rectal temperature (°F)	99.2 ± .3	100.3 101.0	101.2 102.0	102.2 103.0	103.2 104.0
Number of animals..	9	7	10	7	11
Prothrombin time ...	1′47″	4′06″	5′55″	6′10″	8′55″
Standard error	0′10″	0′25″	0′50″	1′04″	0′56″
Group A: Normal rats		Group B–E: Rats in fever			

The degree of this increase of the prothrombin time varied considerably but tended to become more pronounced with higher temperatures. A response to Dicumarol falling within the limits of normal variation occurred only three times among the rats in the stage of fever. To facilitate tabulation the value of 12 minutes was deliberately attributed to experiments in which clotting was delayed for an indefinite period in excess of 12 minutes. This occurred once in Group C and D and five times in Group E. For classification we used the maximal temperature attained during the experiment. Due to the variation of the response and the necessary deliberate form of classification, the standard error of the single groups is considerable, but statistical evaluation has shown that the differences between normal and pyretic rats are significant.

Details and further work in which changes in the metabolic rate were produced by increasing the environmental temperature or by other methods will be reported later. As far as we know, no definite observations of this type have been published so far. Our observations suggest that the administration of this drug should be particularly watched in patients having an increased body temperature, to avoid a dangerous depression of the prothrombin level.

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9 U. S. Dept. of Agriculture, "Food and Life," pp. 476–491. Washington, D. C., 1939.

10 H. R. Guilbert and H. Goss, *Jour. Nutr.*, 5: 251, 1932.

1 Harold A. Campbell and K. P. Link, *Jour. Biol. Chem.*, 138: 1, 21, March, 1941.

2 M. A. Stahmann, C. J. Huebner and K. P. Link, *Jour. Biol. Chem.*, 138: 2, 513, April, 1941.

3 R. K. Richards, *Anesthesiology*, 2: 1, 37–43, January, 1941.

4 H. A. Campbell, W. K. Smith, W. L. Roberts and K. P. Link, *Jour. Biol. Chem.*, 138: 1, 1–20, March, 1941.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR CONCENTRATING SERUM

WITH the current large-scale use of human serum, in both military and civilian medicine, the desirability of concentrating the serum has been manifest, both in order to economize storage space and to facilitate treatment. With the apparatus to be described we have found it practicable to store the equivalent of 250 cc of serum in a 100 cc bottle rather than in the 500 cc bottle previously used.

Concentration may be effected by evaporation through a Cellophane tube supported by a special glass bell (Fig. 1). Seamless tubes of Cellophane,

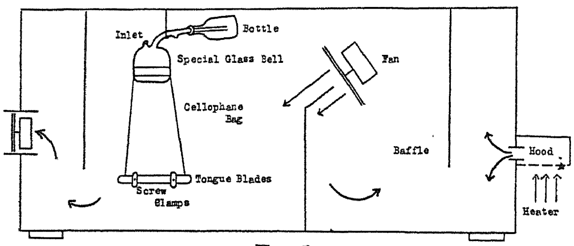

FIG. 1.

known commercially as sausage casings, are used as containers for evaporation. These tubes are cut into 12-inch lengths and the bell is inserted in one end. It is made secure with a one-half inch strip of tape drawn tightly over the adjoining surfaces. The bottom of the tube is closed by folding the bag over a strip of wood. (Tongue blades are excellent strips for this purpose.) This in turn is folded once more and additional tongue blades are securely fastened on each side with screw clamps. To maintain a closed system, the inlet is sealed with a "mushroom" vaccine stopper. The side arm of the bell is wrapped with cotton and inserted into the neck of a 100 cc storage bottle (Kimble vaccine bottle). The cotton forms a bacteria-proof seal between the side arm and the bottle. Paper is then wrapped around the joint to further insure sterility. This entire closed system, consisting of Cellophane bag, glass bell and storage bottle, is autoclaved as a single unit.[1] Serum is introduced into the Cellophane bag through the inlet and the unit is suspended in a vertical position in the cabinet.

The concentrating cabinet is 4 feet long, 1 foot wide and 2 feet high. The individual units are suspended from hooks situated as shown in the diagram. A cabinet of these dimensions will accommodate twelve units.

The cabinet is so constructed that a constant volume of warm air is blown over the Cellophane surfaces. The incoming air is warmed by a "Fletcher Radial" gas burner. The heating unit is covered with a metal hood that is equipped on the under surface with a screen. The flames from the burner pass through the screen (A), but do not go beyond the hood. With this arrangement, air is adequately heated before it enters the cabinet. A constant current of air is maintained by an exhaust fan situated at the opposite end of the cabinet.

It is important that the air brought in at the intake shall be thoroughly mixed with the air in the cabinet in order to insure an even temperature on all the drying surfaces. This has been accomplished by installing three baffles and an electric fan within the cabinet. The fan is so situated that part of the air is blown directly on the bags and the remainder mixes with the incoming air from the first compartment.

We have tried numerous types and arrangements of the baffles and have found the one shown in the accompanying diagram to be the most satisfactory in producing a uniform temperature.

The Cellophane tube as described will handle a volume of 250 cc of serum. By experimenting it has been found that a cabinet temperature of 60° C. will give a fluid temperature in the Cellophane tubes of approximately 30° C. At this temperature, water is removed at a rate of 25–30 cc per hour and concentration to one fourth the original volume is effected in six to eight hours.

After the desired amount of water has been removed, the bag is inverted and the concentrate allowed to flow into the bottle. The bottle is then aseptically sealed with a vaccine stopper and stored in a frozen state.

The apparatus also lends itself readily to the concentration of other biological products.

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[1] When sausage casings are autoclaved and allowed to dry they become brittle. In order to prevent this, we wrap the entire unit in a towel before autoclaving. This retains enough moisture to prevent cracking.

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SCIENCE NEWS

Science Service, Washington, D. C.

NEW SEISMOGRAPH FOR THE NATIONAL ASTROPHYSICAL OBSERVATORY OF MEXICO

EARTHQUAKES and sleeping volcanoes in Mexico will be studied intensively by one of the world's most sensitive seismographs, to be installed in Mexico's National Astrophysical Observatory through the cooperation of American scientific men with the State Government of Puebla, headed by Dr. Gonzales Bautista.

The Mexican Ambassador, Don Francisco Castillo Najera, in Washington, announced the acquisition of the instrument, and Dr. Harlow Shapley and Dr. L. Don Leet, of Harvard University, state that arrangements for the shipping and installation of a Benioff vertical-component seismograph, which has recently been thoroughly tested by Daniel Linehan, of Weston College, have been concluded by the Committee on Geophysical Research of Harvard University. The instrument was provided by the National Research Council in Washington and was originally intended for use in the studies of local earthquakes. Recent events in Mexico have shown that seismographs of this type, located where they will contribute new information about Mexican earthquakes, will contribute also to knowledge of volcanic activity.

The seismograph will soon be installed at Tonantzintla, just east of the famous towering twin mountains, Popocatepetl and Ixtaccihuatl.

This new seismograph is one of the latest models of a type that has proved itself to be among the world's best. It was developed by scientists at the California Institute of Technology. Some of the earliest investigations with Benioff seismographs were made at the Oak Ridge, Mass., station of Harvard University, resulting in the discovery of previously unsuspected minor seismic activity in this area. The great success of Harvard with this instrument has led to its widespread adoption in this country and abroad.

The seismograph produces a record of ground vibrations in the form of lines on photographic paper. It is capable of magnifying ground motions by as much as 250,000 times. At Oak Ridge it records the passing of trains eight miles away as well as earthquakes on the opposite side of the globe.

Mexico is one of the best natural laboratories available for a study of the related problems of earthquakes and volcanoes. There are both active and recently extinct volcanoes and numerous earthquakes. Some of these earthquakes, in fact all that are in the volcanic regions, are unusual in that they occur at distances of around sixty miles below the surface. Just enough information has been accumulated in recent years to cause investigators to be considerably puzzled and extremely curious about the connection between these earthquakes and the volcanoes. This curiosity was sharpened recently by the reported appearance in Mexico of a new volcano in a region where such earthquakes have been occurring over a period of years.

These investigations into the relationship of volcanoes and earthquakes mark an interesting cycle in seismological thought. The earliest theories of the origin of earthquakes held that all earthquakes were caused by volcanoes. Subsequent opinions, based on new facts, held that all earthquakes were caused by crust-distorting forces, and that any relationship to volcanoes is purely coincidental. It now appears that the forces which produce earthquakes in certain areas may also cause volcanic eruptions.

The installation of a high-sensitivity instrument in Puebla will provide an ideal opportunity, one of the few in the world, to study the day-by-day minor manifestations of the forces causing earthquakes and volcanic eruption, contributing perhaps ultimately to the solution of the larger problem of the origin of mountains.

THE SPEED OF CHEMICAL REACTIONS

How the methods by which a chemist determines the speed of a chemical reaction can be effectively used in the fields of physics and biology was described by Dr. Henry Eyring, professor of chemistry at Princeton University, at the University of Louisiana in a lecture which is also to be delivered before local chapters of the honor society of Sigma Xi throughout the country.

Dr. Eyring has developed improved formulas for predicting reaction rates by use of thermodynamics, statistical mechanics and the quantum theory. These formulas can be applied, he pointed out, to such apparently unrelated subjects as the flow of fluids, the velocity of sound and of nerve impulses, the light of luminous bacteria, the action of drugs and of enzymes. They bring a new and illuminating method of investigation into these fields.

The flow of fluids can be pictured as arising from individual molecules jumping from one equilibrium position to an adjacent empty one, just as in a chemical reaction the molecules jump from one position of equilibrium to another one, forming a new compound. The formulas for reaction rate successfully predict the velocity of flow of a liquid. When a liquid is compressed, some of the holes are squeezed out of it. The flow becomes more difficult. The liquid becomes thick—viscous. The picture thus explains this well-known fact.

When a sound wave travels in air, it must be passed on from molecule to molecule. Its speed is the average speed of the heat motion of the molecules. In water, the heat motion of the molecules is the same, but they are closer together. They bump each other more often, so that the sound impulse is passed along about eight times as rapidly as in air.

A nerve impulse travels about one fifteenth as fast as sound travels in water. This is interpreted by Dr. Eyring as meaning that each molecule must make about fifteen tries to get the message over to the next molecule. The light emitted by luminescent bacteria is due to the catalytic action of an enzyme. The catalyzing molecule, after bringing about the oxidation of the luciferin molecule, finds itself in an excited state and emits a quantum of

blue light. Temperature and pressure affect the intensity of the light in the same way they affect chemical reaction rates. Sulfanilamide reduces the light intensity and so does urethane. But the two together reduce the light less than does sulfanilamide alone, indicating that these two drugs are antagonistic and form a combination.

From these studies of luminescence, Dr. Eyring expects a more detailed understanding of the action of drugs and of biological enzymes in general.

VITAMINS

VITAMIN or other dietary means of preventing and curing now uncontrollable diseases, as we now control scurvy, pellagra and rickets, was predicted for the future in a Sigma Xi lecture at Purdue University by Professor C. A. Elvehjem, of the University of Wisconsin.

Recent studies in his own and other research laboratories of the twelve or more B vitamins furnish the basis for Professor Elvehjem's forecast for the future of nutritional research.

Lack of one of the newest B vitamins, folic acid, may be the cause of a blood disorder, a sort of white blood cell anemia, that develops occasionally in patients getting sulfa drug treatment and also sometimes without such treatment. The same condition develops in rats following treatment with certain sulfa drugs, and it also develops in monkeys deprived of the vitamin. The reason the rats get the condition seems to be that the sulfa drugs stop the growth of microorganisms in the rat intestinal tract which normally manufacture some of the B vitamins.

In both monkeys and rats the white blood cell anemia, though induced by diet in the one case and by sulfa drugs in the other, can be prevented by folic acid. The condition may develop following twenty days of sulfa drug treatment because the patients had been on short rations of folic acid and could not stand further depletion by the drug of their reserve supply of this vitamin. "We can only speculate as to the importance of the other factors in human nutrition," Professor Elvehjem concluded, "but I am willing to wager that equally important relationships will develop. As research continues we may learn from it nutritional means of handling diseases which are uncontrollable today as readily as we now control scurvy, rickets and pellagra."

Biotin, inositol and p-aminobenzoic acid are other new B vitamins which the latest studies show may have significance in human nutrition, besides those with which biochemists, nutritionists and even lay persons are now familiar: thiamin, riboflavin, niacin, pantothenic acid, pyridoxine and choline. Two chemically unknown factors needed by the chick for growth and feather production and one or more factors of significance in guinea pig nutrition complete the tally of now known B vitamins.

ITEMS

QUININE content of newly discovered cinchona stands can now be analyzed on the spot by a new portable device instead of sending bark samples to remote laboratories. The first four units have been shipped to South America to speed development of quinine sources and for inaugural tests under field conditions. Knowing that quinine fluoresces or glows under ultraviolet light, Martin S. Ulan, of Rutgers University, consultant to the BEW Office of Imports, went to work with his associates to develop a machine that would make laboratory testing of cinchona bark unnecessary. Starting with an instrument used to test fluorescent minerals, the galvanometer was dispensed with and a set of tubes each containing a different strength of quinine solution substituted; each with a different degree of fluorescence. By comparing these with an unknown sample the quinine content can be calculated. This test, conducted in a few minutes in the heart of the jungle, is expected to be nearly as accurate as more complicated laboratory procedures. Simple instructions included with the new device can be followed by a layman without technical training.

"STRIKING clinical improvement" in nine out of ten patients suffering with "shipyard eye" has been achieved by injections into the veins of blood serum from other patients already recovering from the eye condition, is reported by Dr. Alson E. Braley and Dr. Murray Sanders, of New York, in the *Journal* of the American Medical Association. The group of cases treated is small and further studies with control cases are needed before convalescent serum can be accepted as a cure for the condition. However, since this ailment is occurring in epidemics in industrial areas in many parts of the country, and since no other treatment has materially shortened the course of the disease, it is felt that attention should be called to the possibilities of convalescent serum treatment. Seven of the ten patients were "clinically cured," six of them in forty-eight hours. In two others the normal course of the disease was shortened and corneal changes possibly aborted. One case is classed as a failure because adequate information following treatment could not be obtained.

PLASTIC lithographic printing plates, made from polyvinyl alcohol resin, are reported to be in use in the Army for printing colored maps and other military documents, and in mobile field printing units. Their use saves from three to eight times their weight in critical aluminum and zinc. The development came about through the use of polyvinyl alcohol as a coating on zinc to improve the printing quality of the metal. It became apparent that the actual printing was from the plastic and not the metal, and that other material could as well be used for the base as zinc and aluminum. In the new plate the base is paper impregnated with the polyvinyl alcohol resin which gives it the required strength and stability. It is waterproofed with a coating of another resin. Two sheets are then laminated to form the base, and the printing surface coated with the polyvinyl alcohol resin. Creation of the printing image is the same as with metal. The resin plastic is sensitized with bichromate of ammonia. It is exposed to light, treated with the developing ink, developed in water and etched, and is then ready for use in the press. The development of this plastic for lithograph printing plates was carried out in the laboratories of the du Pont Company, and the plates are made by a Boston company. The Army at present has preempted the entire output, but it is expected will be available at a later date to the printing trade.

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FORTY YEARS OF PLANT PHYSIOLOGY

SOME GENERAL IMPRESSIONS[1]

By Professor EDWIN C. MILLER

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FORTY years ago the work in plant physiology was changing from the old to the new. Those who were interested in the subject were concerned chiefly with the nature of the response of *Mimosa* or similar plants to stimuli of various sorts. In the main, they were not interested at all in any practical or applicable results that might accrue from their investigations. At about the time of my entrance into the field, the conflict between the purist and the practical man was at its height and was being waged bitterly. It is said that some purist when asked of what practical value his findings were in the field of science, replied, "None whatsoever and if I had thought before undertaking the work that they would be of any practical value, I would never have undertaken the investigation." Such a happening may be somewhat exaggerated, but it, nevertheless, illustrates the state of mind of some of the individuals who waged this bitter conflict. This condition illustrates the same spirit that was expressed by the so-called "malefactors of great wealth" who are reputed to have said that "the public could be damned" as far as they were concerned.

The public, rightly or wrongly, may eventually reach the stage where the workers not only in plant physiology, but also in most other lines of scientific work, must show that the results of their labors will contribute to the happiness or advancement of man-

[1] Address of the retiring president of the American Society of Plant Physiologists, December, 1942.
Contribution No. 443, Department of Botany, Kansas Agricultural Experiment Station.

kind before it will consent to grant the request of these workers for pecuniary aid in pursuing any investigation. This reaction of the public has an influence that is felt even in the privately endowed institutions. This attitude of the public may be wrong, but right or wrong, it exists and any one interested in research must reckon with it. The practical aspect now dominates investigational work in all regards and the so-called purist, especially in plant physiology, is now prominent only on account of his absence. Now we say that it was foolish to fuss over such a question for no one can tell when a scientific discovery even of the purist type may become of the utmost practical importance. Let us illustrate this fact from experience.

In 1924 I published a paper in the *Journal of Agricultural Research* entitled, "Daily Fluctuations of the Carbohydrates in the Leaves of Corn and Sorghums." No practical importance was attached to the results at that time and they were believed to have none. The facts were observed and it was considered worth while to give them to the world. Within five years after the appearance of this article, the Dairy Department at Kansas State College noted that silage varied markedly in its acidity. Those who were investigating this problem were worried greatly because they could find no cause for this difference in reaction. Some one in the Dairy Department, however, had read the paper just mentioned and wondered if the amount of carbohydrate in the sorghum plant at the time it was cut might not have some influence upon the acidity of silage. He called the attention of the investigators to the paper and to his surmise relative to the acidity. Further study proved that the time of day at which the plant was cut did have an influence upon the acidity of the silage. A purely scientific discovery thus became a practical one.

Forty years ago the work on the composition and action of enzymes dominated the field of plant physiology. We fully believed that the riddle of the universe would be solved when the nature of their composition and action was discovered. The biological workers have since found and proved many facts relative to the structure and mode of action of enzymes, but the ultimate cause of these problems has never been explained to the satisfaction of the student of plant physiology.

After the study of enzymes there followed that of the water requirement of plants, their point of permanent wilting, drought resistance, root systems, the effect of the H-ion concentration of their cells and of the medium in which they grow, the effect of ultraviolet light on their growth and development, photoperiodism, their resistance to heat and cold, their reaction to the carbohydrate/nitrogen ratio, growth substances, hormones, vitamins and numerous and varied other studies. The investigator may be prone to consider his particular problem one of the most fundamental of those confronting mankind to-day. The solution, however, of each of these problems is yet far distant. The present status of many of these problems can be stated by using the following illustration.

During the second year of our graduate work at Yale University, an extensive publication was discussed in weekly seminars for two months or more. It was a detailed review of the research work that had been done along various allied lines. The author would survey the research that had been completed in each phase, then close with a statement that read somewhat as follows, "Much work yet remains to be done on that subject." This statement was repeated so frequently that it became trite among the graduate students and their instructors.

From the viewpoint of many of us, scientific investigators have never completely solved any problem and it is doubtful if they ever will, even though they keep investigating a problem continuously. Many times, however, they leave the problem upon which they are working to enter what appears to them to be more remunerative fields.

Scientists behave and remind us very much of the actions of youngsters of our boyhood days. The Ohio Canal went within 500 yards of my country home and the boys and girls of that neighborhood fished along it. Suppose a dozen were fishing along its placid bank within a distance of a quarter of a mile. Suddenly one would land a fish larger than those generally caught. Immediately eight or nine of the boys and girls would run to that point to fish and cast their lines into the water. There were no more big fish in that particular spot than elsewhere, but the boys and girls evidently thought so.

Scientists behave relative to their scientific work much as did these boys and girls. Whenever a fellow research worker discovers an outstanding fact, literally hundreds of workers shift their investigations to that field and try to find some phase of it in which to work. We have long noticed the behavior just mentioned and wondered as to the reason why investigators behave as they do. We asked a colleague to explain such behavior. He too had noticed the same trends and had made up his mind on the subject. He replied almost instantly, "The vast majority of scientists do not think for themselves and the discovery of a new fact which promises to be of great importance stimulates them to greater activity. The only way they can show their ability is to follow in the footsteps of the fellow who has demonstrated the ability to think." We are inclined to believe that our colleague was right in his interpretation of the general

behavior of scientists. We may be wrong in our reasoning on the cause of certain fluctuations in trends of research, but most of us will agree that investigational work goes in fads or cycles just as certain styles dominate the wearing apparel of both sexes of the human species. Likewise, we are all agreed that the progress of plant physiology, as in the advancement of all scientific endeavor, is due to the resultant of the efforts of thousands of ordinary investigators and that its progress is not due to the work of any individual or even a small number of workers.

We have also observed during the past forty years that a newly discovered fact seems quite simple in all regards. It is so apparent that we are amazed that it was not discovered long ago! However, as more and more is learned on the subject, it increases in complexity until the solution of the problem which at first appeared so simple is lost beyond recognition because of the complexity of the questions raised by it. Let us consider two cases which illustrate this point. First, let us consider the problem of growth substances. The first discoverer of their action considered that he was working with a single substance. All that needed to be said was that a certain reaction was caused by a *"growth substance."* Then after the problem was further investigated it was found that there were at least three different components of the growth substances, *viz.*, auxin *a*, auxin *b* and heterauxin or indole 3 acetic acid. Then investigators showed that there is a long and varied list of organic compounds that may produce the same effects as these growth substances. Whether the plant secretes all these substances is so far unknown. However that may be, it is certain that when we say "growth substance" at the present time, we must qualify and state the particular substance to which we refer. Thus we have an illustration of a subject that has become more and more complex as investigations have progressed.

The same situation could also be illustrated by considering the discovery of the carbohydrate/nitrogen ratio. This expression was considered a relatively simple one when it was first discussed, but as investigations proceeded, it became more and more complex. The question immediately arose as to the meaning of the expression. To some it meant the total carbohydrate/nitrogen ratio, to others the carbohydrate/insoluble nitrogen ratio, yet others believed that the starch/nitrogen ratio was the one to consider, while others felt that the total carbon/total nitrogen ratio was the important one. This disagreement of the exact ratio to be considered, coupled with the numerous ways by which it might be varied, together with the impossibility of attaining the desired ends because of conditions over which no one has any control, makes it one of the most complex problems for application.

The author has seen much water pass under the bridge in regard to the many problems left unsolved by those working on them. These problems have been deserted because the individual has become disgusted with his lack of progress or has entered new fields of research that seemed more promising. Alas, in most instances he soon finds that he has been chasing a will-o-the-wisp and his new love proves just as cold and unresponsive as the one he deserted. We thus refuse to be excited to any degree by a discovery in plant physiology, although the new discovery is blazoned to revolutionize the efforts of mankind. We are thus frequently the cause of considerable alarm to our young colleagues who have not been through the mill and are not veterans in the service.

We have been impressed with the fact that no problem has ever been totally solved. This point is illustrated by considering the history of the elements that are essential to plant life. The number of elements was formerly designated as ten. This fact was determined and considered settled over fifty years ago. It was so considered because it had been thoroughly proved by experimental methods. The problem, however, was not destined to remain in quiescence for all time. It was later discovered that the investigators had made numerous and varied mistakes in their procedure which induced serious errors in their results. A new series of investigations was then begun on a problem that had long been considered solved. As a result there has been more research work during the past ten years on nutrient solutions, primarily with the idea of determining the elements that are essential to plants, than in any other field of plant physiology save that of growth substances. The results have been most gratifying and, so far, the number of essential elements has been increased from 10 to 12. Several others are yet in dispute. These results should convince all scientific workers of the danger or folly of considering any problem fully solved.

We are convinced from our experience that to be a good investigator, the individual must be in that type of work because he is "born that way." By that we mean that he must be a person who, because of his temperament, likes the investigational type of work and is happy doing it. A good research worker, with but few exceptions, must be patient, a plodder and an individualist with a one-track mind. He must hew to the line and let the chips fall where they may. He must consider that the problem on which he is working, no matter how small it may seem to the average person, is the all-important one and that all others are more or less subsidiary to this one. Thus many scientific investigators could well be classed by their neighbors and compatriots as narrow folks who know little and care less about general affairs. That is perhaps the chief cause for their being irritable and prone

to call a fellow worker names because he has obtained results that differ from theirs under what appear to be similar conditions. This may be illustrated by the well-known work of Eckerson in 1914 on the permeability of the protoplasmic membrane to solutes. She found that the permeability of the cells of roots depended on three main factors which may be listed as follows: (a) on the temperature range considered, (b) upon the type of plasmolyzing agent used, and (c) upon the type of plant.

Let us consider the case of the cells of the radish root, using a solution of potassium nitrate as the plasmolytic agent. She found that from a 10° to 14° C. range of temperature, the permeability of the protoplasm of these cells increased with a rise of temperature; that from 18° to 24° C. the protoplasm of these cells showed no change in its permeability with a fluctuation in temperature; from 24° to 40° C., the permeability of the protoplasm of the cells of this root increased with a rise in temperature; but from 40° to 50° C., the permeability of this protoplasm decreased.

Now suppose one investigator desired to study the influence of temperature on the changes in permeability of the protoplasmic membrane to solutes. Suppose he would choose the radish root and potassium nitrate as the plasmolytic agent and would choose as his range of temperature 18° to 24° C. He would find that the permeability of the protoplasmic membrane would not change over that bloc of temperatures with an increase or decrease in their value. Let us suppose that another investigator would choose the same plant, the same plasmolytic agent, but would choose for the range of temperature 40° to 50° C. He would find that an increase in temperature in that range would decrease the permeability of the protoplasmic membrane to solutes, while a decrease in temperature would increase the permeability. A third investigator might choose the same plant, the same plasmolytic agent, yet choose the range of temperature from 24° to 40° C. in which to work. Inside such a bloc of temperatures he would find that the permeability of the protoplasmic membrane to solutes would increase. Thus under identical conditions except temperature, each investigator would obtain different results. They would all be right. In times past each would have considered the other a fraud or a liar and would not have hesitated to say so publicly.

Privately, we can forgive a research man for speaking hastily because, as previously mentioned, his narrow attitude is one of the characteristics of a good investigator. The public, however, will not be so liberal as to pardon such behavior and will not tolerate such an attitude. We are becoming, whether we like it or not, more and more the servants of the public which is exercising increasing demands on all who in any way may be subject to its will. It looks to its servants for cooperation and leadership. The public in the future will not tolerate any antagonism between research workers. It will see to it that workers in research are congenial to all, including fellow workers. Whether this requirement is better than the old is a moot question in many regards, but right or wrong, the new method is the one that is in the saddle.

We often recall the experience of a former colleague who went to Europe many years ago for advanced study. He planned to "sit in on" the lectures of several noted men in agriculture because he knew professionally of the excellence of their work along special lines. When he arrived abroad he talked with these various professors relative to taking their lectures and all said they would be delighted to have him. Towards the end of his rounds in asking the various professors relative to sitting in on their lectures, he happened innocently and inadvertently to mention that he was also going to take the lectures of Professor X. Instantly the scientist to whom he was talking changed his cordial attitude and bluntly said, "If you listen to the lectures of that man, I will have nothing whatsoever to do with you." The American was nonplussed and had reasons to be so. Practically all American scientists would not hesitate to agree that such an attitude was most damnable. Yet in this country we have attained a similar attitude in many of our institutions of higher learning.

A graduate student who goes to some institution of higher learning soon belongs or is told bluntly that he belongs to such and such a clique. He soon learns that he can not even talk in the hallways to the leader of any other clique or even any of the followers of this man because if he does so, even in the most perfunctory manner, he is immediately marked by a member or the leader of an opposing clique as belonging to the group that opposes them. Such a condition is deplorable, yet it exists to-day in numerous of the large and leading educational institutions of our land. The average graduate student is greatly distressed and bewildered at the whole affair and rightly so. He has been taught that one of the main objectives of an education is to attain a more tolerant attitude towards all subjects and toward all people. He can not leave such ideals even though in scientific training we teach him to know more and more about less and less. To our way of thinking the great keystone in the advancement of science is tolerance to the views of others whether we agree with these views or not.

For almost thirty-five years the writer has been an instructor at Kansas State College and an investigator in the Kansas Agricultural Experiment Station.

That my colleagues and myself within that time have accomplished a few things relative to the teaching of plant physiology and along the line of physiological investigations, we believe no one will deny. We can say truthfully and in all sincerity that no rivalry whatsoever relative to the subject-matter to be investigated exists between the various departments of this institution. We talk without restraint to various members of other departments and ask their advice about work that we are doing. They in turn are free to consult us relative to matters in which they are engaged.

Recently one of our students who had finished his undergraduate work at this institution went to a neighboring university to see about taking graduate work leading to the doctorate. He found, to his consternation, that the botany and the chemistry departments of the institution were at swords' points because each felt that certain members of the other department were transgressing upon their sacred domain. This graduate student came back to our institution a sadder but wiser man. He had not realized until that time that such bitter rivalries exist within educational institutions.

There is unquestionably sufficient truth in any field to satisfy the most arduous workers of all parties. The liquor of our own vintage unquestionably is good but if we should mix the drinks from all sources, we would truly have the real nectar of the gods. We are not a prophet or the son of a prophet, but we predict that unless we quit fussing over tweedledum and tweedledee, the fate of our investigations is sealed, for the public that furnishes us the funds with which to conduct our research will withhold them from those who can not conduct investigations in a cooperative way.

Another fact that has been impressed upon me during forty years of experience is that one may know all about a certain subject and yet be a miserable failure as a teacher. He may be considered a "nut" and no more by his fellow men. We are convinced that to succeed as a teacher, not only in plant physiology, but in any field, two prerequisites are necessary. (a) He must know his subject and keep informed concerning its progress at all times, but (b) he should have common sense. We have frequently been taken to task because we have preached and advocated the last-named characteristics as a prerequisite of success. So far, we have been subjected to no arguments that have in any way whatsoever changed our idea relative to the matter. We would list under the term "common sense" three main factors that we believe make up the meaning of that word: A sense of humor, a knowledge of human nature and a trustfulness in humanity. If any individual possesses these three characteristics to a marked degree and if he, in addition, has a thorough knowledge of his subject, he will succeed as a teacher in his chosen field.

The observations and suggestions that have been listed in this paper are a few that have impressed us in our experience in the field of plant physiology during our forty years of experience in that realm. They are not new thoughts and they have been preached by many from the time that investigational work had its origin. We are convinced that the impressions gathered during our years of experience, if followed even to a limited extent, will benefit both the investigator and the field of plant physiology.

A NEW BLOOD-CLOTTING THEORY

By Dr. JOHN H. FERGUSON

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THE difficult subject of blood coagulation has been so beset by inadequacies of the numerous and often conflicting theories, in the light of experimental fact, that the author has labored for nearly a decade with an experimental approach and great hesitancy in propounding a comprehensive theory. Despite the complexities encountered and many "loose-ends" still to be brought into line, current interest in the preparation of plasma and hemostatics for war use makes the time ripe for presentation of a "working hypothesis" for the stimulation of continued research and, particularly, for the guidance of the many whose interest is at present confronted by the sad lack of agreement among so-called "experts" in the field. The experimental basis for the views here presented is to be found in the author's contributions and reviews, in such coagulation reviews as those in *Ergebnisse der Physiologie* (Morawitz, 1905; Wöhlisch, 1929; 1940), in the chapters on proteolytic enzymes and "thrombase" in Oppenheimer's "Die Fermente und ihre Wirkungen" and in Northrop's "Crystalline Enzymes."

It has long been agreed that the essential feature of blood coagulation is the (specific) conversion of a plasma protein fraction (fibrinogen) from the state of a colloidal hydrosol to that of the corresponding quasicrystalline (oriented micelle) gel (fibrin), and that this is the second of a two-phase process, the first being the elaboration of an essential agent (thrombin) from an inactive, probably protein, pre-

cursor (prothrombin), now known to be also a plasma-, rather than a cell-, constituent.

It has generally been recognized that the normal maintenance of the fluidity of the circulating blood is due to the absence of active thrombin. Since the blood, even the plasma devoid of all formed elements, can be shown experimentally to be a source of all the known factors (prothrombin, ionizable Ca, cephalin, etc.) required for thrombin formation, the problem has been why the necessary reactions do not normally occur in fluid blood.

Morawitz's name is particularly connected with the theory of lack of specific "activators" (of prothrombin), and his term "thrombokinase" and the almost identical term "thromboplastin" (Howell) have continued as working names ("shop numbers," if you will) for their designation. Bordet added some new facts and a nomenclature which only complicated the issues. Howell (Wooldridge, Zak and Bordet said "lecithin") identified the phospholipid *cephalin* as a chemical component of "thromboplastin," but, significantly, went on to develop the rival theory, *viz.*, that the failure of thrombin formation was due to specific "inhibitors." An important outcome of this work (with his pupils McLean and Holt) was Howell's second chemical discovery, "heparin," together with firm foundations for the more recent researches as to its mode of action. The simplicity of the Howell theory has had wide appeal, but "coagulationists" have raised many experimental objections. The first is a definite suspicion that the heparin demonstrable in blood is an artefact of the mode of separation or demonstration. A second is that no satisfactory explanation is forthcoming of the mode of removal of the heparin-type inhibitors in clotting blood. Howell, himself, is forced back to a theory of "neutralization" by "thromboplastin." So, in a roundabout way, both theories come back to this ill-defined agent which is undoubtedly not merely a cephalin-protein compound.

Alex. Schmidt, the father of the "thrombin theory," proceeded from the assumption that blood coagulation (like that of milk) was essentially a protein-enzyme reaction. Nolf and others contributed much to an enzyme view which was fraught with the fallacy that thrombin is, itself, a proteolytic enzyme. We believe this to be fallacious because the purest and most potent thrombins are quite (or almost) free from the ability to produce fibrinolysis and more complete proteolysis (*e.g.*, positive biuret and ninhydrin tests, increase in –COOH (formol titration) or in amino-N). Trypsin will digest, but will not clot, prothrombin-free fibrinogen. One proteolytic enzyme, papain, will do both.

A vast amount of work, with very little direct bearing on blood coagulation, had as its starting-point the "Abderhalden reaction," *i.e.*, the alleged appearance in blood serum of proteolytic enzymes, specific for parenterally injected ("foreign") proteins. The positive evidence for such phenomena has continued to pile up, despite the well-founded objections of biochemists and immunologists. At the same time, the valid objection, that non-specific proteases can be demonstrated in tissue- and blood-cells and in serum, is equally factual. Oppenheimer points out that the serum enzymes are chiefly "tryptases" and "peptidases." A. Schmitz gave clear indication of a complex plasma system composed of (1) inactive precursor or zymogen (for which we should like to suggest the term "tryptogen," in analogy with pancreatic trypsinogens); (2) specific antitryptase; (3) kinase (activator) required for the tryptase to be liberated in active form. The analogy to the pancreatic trypsin system (ref. Northrop) is complete.

As far back as 1913, Collingwood and MacMahon produced thrombinolysis and hence inhibition of coagulation of blood by trypsin and suggested possibilities for the theory of clotting. Eagle (1937) reviewed subsequent work on trypsin in relation to blood coagulation. When Northrop and Kunitz showed their crystalline trypsin to be a coagulant, and Eagle, followed by the author, both using the crystalline enzyme, confirmed earlier work showing that the mode of action was "thromboplastic," the way was opened for re-investigation of the old data on blood enzymes. It had long been known that blood serum is able to inhibit preparations of pancreatic trypsin. Northrop's crystalline trypsin-inhibitor (from pancreas) prevented trypsin from clotting $MgSO_4$-plasma. The author, in some unpublished experiments[1] with a similar inhibitor preparation (supplied through the courtesy of Dr. T. E. Weichselbaum, of Washington University, St. Louis), finds evidence of inhibition of ordinary clotting (!) of recalcified plasma by the crystalline inhibitor. The data indicate anti-fibrinolytic as well as anti-prothrombic and anti-thrombic effects. A co-factor is necessary, at least for the last, and can be supplied in crude plasma albumin. These actions closely resemble *heparin,* but are much weaker. Can it be that the pure polypeptide has a "heparin-like" acid-prosthetic group? Heparin is anti-tryptic.[2]

Ferguson believes that the natural blood tryptase (when freed from inhibitor and "activated") is the "missing-link" in the "thromboplastic" activation of prothrombin to thrombin. If present in sufficient amount and under adequate conditions, this tryptase can also *digest:* (1) prothrombin and thrombin (hence constituting "progressive" antithrombin);

[1] Ferguson, *Proc. Soc. Exp. Biol. and Med.*, 1942 (in press).

[2] Horwitt, Science, 92: 89, 1940; Glazko and Ferguson, *Proc. Soc. Exp. Biol. and Med.*, 45: 43, 1940.

(2) fibrinogen and fibrin[3] (hence the term "fibrinolysin" is superfluous); (3) non-specific substrates such as casein (in which small increases in formol-titration and N.P.N. have been occasionally observed). There can be little doubt that "active" tryptase is not normally present in the blood but requires "damaging" or disturbing procedures such as trichloracetic acid precipitation, shaking with chloroform (long known as an "antitrypsin" neutralizer), dialysis, etc. Still to be explained are the exact mechanisms of such "damage" in shed blood, but the fact that profound disturbances in colloidal equilibria do accompany "wetting" (contact with foreign surfaces) and the whole set of conditions encountered *in vitro* can not be denied. Autolysis of damaged tissue cells is an analogy, and the ease of trypsinogen activation is confirmed by Northrop's experiments with the crystalline substance. That "tryptogen" activation proceeds *autocatalytically* is suggested by some recent experiments[4] relating tryptase liberation to actual clotting.

The wide applicability of the new theory is indicated by the following chosen illustrations:

(1) Hemophilic[5] plasma (*in vitro*) is readily clotted by trypsin (and crude tissue "thromboplastins") when cephalin, alone, is of little avail.

(2) Danger of intravascular coagulation at present offers an insuperable obstacle to intravenous use of trypsin as a hemostatic, but ways of overcoming this serious obstacle may possibly be found.

(3) Serum-tryptase accounts for the instability and spoilage of plasma and plasma protein preparations. At present these difficulties are being overcome, very satisfactorily, but empirically, in the war production of plasma substitutes and hemostatic agents.

(4) Many anomalies in the experimental literature on blood-clotting find a ready explanation in the light of the various actions of trypsin.

(5) Close links are forged between blood-coagulation and immunological fields, and the two fields merge in the consideration of "transfusion reactions" and anaphylactic shock.[6]

In summary, the new clotting theory revolves around the proteases of the blood (plasma and formed elements) and tissue cells. Normally, the enzyme is not in the active state. "Damage," *i.e.,* colloidal disturbance, introduces new conditions favorable to activation of the enzyme. Tryptase, optimally in conjunction with ionized calcium and free phospholipid (cephalin), acts as a "thromboplastic" agent for the conversion of prothrombin to thrombin.[7] Thrombin is enzyme-like in potency and in the kinetics of its interaction with fibrinogen to form fibrin. Proteolytic phenomena such as fibrinolysis and a trace of ordinary protein cleavage are variable and due, not to thrombin, but to continuing action of serum protease. We can leave to the immunologists the problems of "foreign" protein cleavage but suggest that they look for quantitative changes in normal protease-inhibitors.[6]

In this theory, the important natural anticoagulants are tryptase-inhibitors. They seem to be present in normal plasma (and serum) and may be polypeptides with acidic (heparin or heparin-like) prosthetic groups. We do not wish to go so far as to assert that they must have the chemistry of heparins (mucoitinpolysulfuric-esters, Jorpes *et al.*). Our erstwhile colleague, Dr. A. J. Glazko, now on active service with the U. S. Navy, clearly showed that heparin is "specific" only in a physico-chemical sense. Analogous inhibitions may be produced with many agents, *e.g.,* polyvalent anions, sulfonic dyes and certain lipids (Jobling and Peterson; Chargaff), also the *basic* protamines (Ferguson, *et al.*). The antithromboplastic, anti-prothrombic and anti-thrombic actions of these inhibitor mechanisms form three defense lines against the untoward possibility of coagulation *in vivo.*

Our hypothesis combines the Morawitz and Howell and Nolf view-points by bringing all three into line

[3] Timing of fibrinolysis with the aid of the Evelyn photoelectric colorimeter is recommended as a simple and very sensitive method for assay of active tryptase (Ferguson, *Proc. Soc. Exp. Biol. and Med.,* 1942, in press). Clot-retraction (syneresis) is merely incipient fibrinolysis (Hirose, 1934; Ferguson, 1939). Tagnon's recent fibrinolytic studies (*Jour. Lab. and Clin. Med.,* 27: 1119, 1942) afford strong support for the major premises of the Ferguson theory.

[4] Ferguson, *Jour. Lab. and Clin. Med.* (in press, 1942).

[5] Feissly (*Helvet. Med. Acta,* 8: 823, 1941) uses a gelatine liquefaction technic to confirm the suggestion of Ferguson (*Am. Jour. Physiol.,* 126: 669, 1939) that hemophilia is a plasma defect in available protease. This view is further confirmed by Tagnon, Taylor, *et al., Jour. Clin. Invest.,* in press, 1942.

[6] Burdon, *Proc. Soc. Exp. Biol. and Med.,* 49: 24, 1942.

[7] The fact that we have prepared prothrombin incapable of activation by Ca alone (despite the presence of cephalin, bound to the protein, demonstrated by analysis) and that the further addition of the pure "free" phospholipid quickly and completely converts it into a stable thrombin able to produce stable fibrin clots (*i.e.,* no evidence of tryptase), causes us, tentatively, to hold on to the view that the thromboplastic role of tryptase consists in catalyzing the formation of a prothrombin + calcium + cephalin "intermediary" complex in thrombin formation. The "final" thrombin can be obtained completely free from Ca and P-lipid. The proved ability of tryptase to activate prothrombin in oxalated or citrated materials (in which Ca-ions, as well as Cephalin, are "bound") is somewhat difficult to fit in with our (1936–1939) "cephalin availability" theory and the answer must be found in the future preparation of a purified prothrombin, completely freed from all, even bound, calcium, phospholipid and serum-tryptase. It is to be regretted that several recent attempts at prothrombin purification have been so concerned with the question of potency as to give scant attention to the equally significant problem of getting rid of these known chemical impurities, to which important characteristics of the allegedly "pure" preparations may very well be due.

with the newer knowledge of tryptase enzymes and their inhibitors. The subject is necessarily complex in view of the difficult and imperfectly understood chemistry. Nevertheless, we believe our solution to be a logical one and sufficiently in accord with a wide knowledge of experimental fact to satisfy the requirements of a "working hypothesis." Such is valuable in the assessment of current progress, in planning experiments for the future, and, above all, in its clear applications to immediate practical aims.

OBITUARY

DR. SUSAN P. NICHOLS, 1873–1942

DR. SUSAN P. NICHOLS, emeritus professor of botany of Oberlin College, was born at Brownville, Maine, on May 12, 1873, and died at her home in Portland, Maine, on December 7, 1942. She was graduated from the Brunswick High School and Bradford Academy, and from Cornell University with the degree of B.S. in the class of 1898, remaining at Cornell as a fellow, 1898–99. During the following year she occupied the American Woman's Table at the Naples Zoological Station. After teaching science at Houghton Seminary, New York, she studied at the University of Wisconsin, receiving her Ph.D. in 1904, with a thesis on Binucleate Cells in Basidiomycetes.

Following two years of teaching in a private school in Kentucky, she came to Oberlin as an instructor in botany in 1908 and remained at that institution until the end of her teaching career. In 1925 she was made professor, and on the retirement of Professor Frederick O. Grover, succeeded him as head of the department. This position she held until her own retirement in 1938. Her membership in scientific organizations included the American Association for the Advancement of Science, American Society of Naturalists, Botanical Society of America, Ohio Academy of Science and the Josselyn Botanical Society of Maine.

Her published work, other than the thesis mentioned, has to do with the physiology of algal cells, but her final illness interrupted work on native orchids in which she had been engaged for some time. This brief record does insufficient justice to her services for science. Her influence on students was notable. Despite the handicap of a withered arm, she was a skilled technician who aroused in her students an enthusiasm for clean and careful technique. She was blessed with a forthright and lucid New England mind which could give direction and perspective to this skill. The impact of her rugged honesty on the minds of her students was powerful and salutary. This honesty, with her common sense and force of character, also won for her a position of influence in the councils of the democratically governed college on whose faculty she served for thirty years.

PAUL B. SEARS

DEATHS AND MEMORIALS

DR. LEONHARD STEJNEGER, head curator in biology at the U. S. National Museum, died on February 28 in his ninety-second year.

DR. LILLIEN JANE MARTIN, professor emeritus of psychology at Stanford University, died on March 26 at the age of ninety-one years.

DR. WILLIAM EDGAR CALDWELL, professor of clinical obstetrics and gynecology at the College of Physicians and Surgeons, Columbia University, and associate director of the Sloane Hospital of Columbia University, died on April 1. He was sixty-three years old.

JOHN A. NEWLIN, who retired from the staff of the U. S. Forest Products Laboratory at Madison, Wis., on March 1, died on March 27 at the age of seventy-one years. He had been with the Forest Service since 1904.

PALEMON HOWARD DORSETT, agricultural explorer, recipient of the Meyer Medal for distinguished service, for forty-one years horticulturist with the U. S. Department of Agriculture, died in Washington, D. C., on April 1 at the age of eighty-one years.

MAJOR LEONARD DARWIN, fourth and last surviving son of Charles Darwin, died on March 21 at the age of ninety-three years.

PROFESSOR ANTONIO CARDOSO FONTE, Rio de Janeiro, Brazil, formerly director of the Instituto Oswaldo Cruz in Rio de Janeiro, known for his work on tropical diseases, died on March 27 at the age of sixty-three years.

A RESOLUTION to declare February 11, 1944, Thomas Alva Edison Day in memory of the inventor, was approved on March 29 by the Judiciary Committee of the U. S. Senate.

A MONUMENT to the memory of William H. Jackson, pioneer artist and photographer of the early West, was dedicated on Sunday, April 4, at Arlington National Cemetery by the Explorers' Club of America and the American Pioneer Trails Association. The occasion was the one hundredth birthday of Mr. Jackson, who died last year at the age of ninety-nine years. Mr. Jackson made the first photographic record of "Old Faithful" in Yellowstone National Park. He later served as official photographer with the U. S. Geological Survey.

SCIENTIFIC EVENTS

THE NEW YORK BOTANICAL GARDEN

At the recent annual meeting of the Board of Managers and the Corporation of the New York Botanical Garden, Dr. William J. Robbins, director of the garden, described how the war effort had been aided not only through the men from the staff who have gone into war service, but also by the furnishing of information to government agencies and to individuals concerned with effects of the war. It was made clear that it is because of the program carried on through years of peace in training men and accumulating botanical information and collections that the garden is able to respond effectively to war demands.

Dr. Robbins stated that despite the exigencies of the war situation, an effort was being made to keep the garden running on as nearly a normal scale as possible, particularly in the way of displays for the enjoyment of the public, in the pursuit of scientific work and in instruction. Because of the importance of the home culture of vegetables at this time, the garden has expanded its program in gardening education and has put on several new courses in vegetable gardening, two of which, given in cooperation with *The New York Times,* attracted audiences of 500 persons each.

In describing specific war services, Dr. Robbins said that the Office of Strategic Information had been furnished with photographs and special maps of areas in which the staff of the garden had collected plants in years past. Leaves of tropical trees for studies on camouflage have been furnished. Crude drugs, collected by the late Dr. H. H. Rusby more than forty years ago and preserved in the collections, have been supplied for chemical study. Six months from now new supplies can be obtained from South America. The only available supply of these materials at the moment is in the museum cases of the garden. Plants have been identified, information and other services pertaining to the war have been furnished to the Navy, the War Department, the Office of the Censor, to magazines, commercial firms and individuals.

In addition to the men who have joined the Army, Navy or Air Force, several in addition to former students have left for tropical regions, where they will be engaged at least for the duration of war in the study and production of critical plant products, such as rubber, quinine, sisal and many others.

Horticultural achievements of the past year include the planting of the Pelham Parkway entrance with 332 trees, the planting of 600 rhododendrons in their permanent places near the present rhododendron glade and the preparation for additional future plantings by making 29,000 cuttings of woody plants, lining out 15,000 other cuttings and setting 4,000 young plants out in the nursery.

Definite future plans include a new rose garden in the vicinity of the Main Conservatories, an addition to the greenhouse to provide for more extensive flower displays, new landscaping, a rearrangement of roadways and the construction of a restaurant and comfort station on the grounds.

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

A special committee appointed by President L. M. Hutchins opened and canvassed the official 1942 ballots of the American Phytopathological Society. As a result of this election, Dr. J. C. Walker, department of plant pathology of the University of Wisconsin, was elected president for 1943. Dr. J. J. Christensen, of the department of plant pathology of the University of Minnesota, was elected vice-president, and Dr. J. G. Leach, of the department of plant pathology and bacteriology of the University of West Virginia, was elected councilor for two years. The old and new officers and members of the council met at Columbus on February 12 and 13 to conduct necessary business. At the same time the War Committee of the society met and passed the following resolutions:

1. That in view of vital needs for increased food, feed, fiber and oil production—plant pathologists of the United States immediately undertake to get the 1943 recommendations for control of diseases of all war goal crops into active use, employing all available channels to that end.

2. The declaration of a nation-wide seed treatment campaign for the reduction of plant disease losses of the essential crops in the war production program with special emphasis on oats, barley, wheat, sorghum, flax, corn, cotton, peanuts and certain vegetable crops as a means of insuring against poor stands and as a means of stretching limited seed supplies.

3. That efforts be made to include established plant disease control recommendations into the action programs for achieving war crop goals.

4. That to prevent waste of vegetable seeds the War Committee of the American Phytopathological Society recommends that Victory gardeners protect their seed from decay and improve stands of plants by treating seeds with disinfectants known as Semesan or Spergon or in accordance with recommendations of their State Agricultural Extension Services and Experiment Stations.

5. That plant pathologists in each state be urged to make every effort to obtain information on the development of major disease hazards throughout the season with the aid of such other agencies and individuals as may be available, with a view to the issuance of timely warnings to growers and recommendations of immediate measures to be taken to check epidemics or to lessen losses that would otherwise result.

6. That the Seed Treatment Committee of the society be asked to prepare 1943 recommendations for the seed treatment of wheat, oats, barley, sorghum, flax and corn for distribution to all States.

7. That the Seed Treatment Committee be encouraged to work with seed producers and seedsmen with a view toward getting more seeds treated prior to distribution and sale, and/or getting directions for treatment printed on packages or packets and in seed catalogues.

8. That the Vegetable Seed Treatment Sub-committee of the society be asked to prepare seed treatment recommendations for Victory gardeners and for commercial vegetable growers and distribute to all States through the War Committee.

9. That the Seed Certification Committee's efforts to obtain the treatment of certified seed be endorsed.

10. That the Fungicide Committee of the War Committee be asked to distribute promptly a condensed statement of their present opinions as to measures for conserving fungicides.

THE AMERICAN ASSOCIATION OF CEREAL CHEMISTS

THE twenty-ninth annual meeting of the American Association of Cereal Chemists will be held at the Hotel Jefferson, St. Louis, from May 17 to 19. Five different phases of cereal technology will be under discussion, these being divided into the following subjects: Industrial Utilization of Cereals; Agronomy and Milling Technology; Brewing and Malting Technology; Baking Laboratory Methods and Baking Technology; The Firing Line with Cereals. The last subject will occupy the whole day on May 19.

Ex-Governor Herbert H. Lehman of New York, director of foreign relief and rehabilitation operations at Washington, will make an address on the opening day on "The Problems of Feeding Starved Nations."

Thirty-eight papers are scheduled for the program, the industrial utilization of cereals being emphasized throughout, thus giving to it a highly practical aspect. Among the topics to be discussed are The Bacterial Fermentation of Cereal Carbohydrates; The Distillation Industry in War and Peace; Industrial Utilization of Corn Proteins; Oil Products from Cereal Grains; Industrial Uses of Wheat Proteins; The Grading and Storage of Grains; Entomology and Insection Control of Grains; Practical Technical Applications and Control in Bread Baking; Macaroni and Noodle Manufacture, as well as in Cracker and Cookie Manufacture and Cake Baking, and the Application of Cereals in the Malt Industry. These general topics show the industrial character of the program. Other subjects of equal value in the chemistry of cereals and cereal technology will be presented.

A general invitation is extended to all who may be interested in attending the meetings to take part in the general discussion of the papers, for which an ample time allowance has been made.

GUGGENHEIM FELLOWSHIPS, 1943

BELIEVING that the continuous fostering of research and creative work is necessary for the development of the values that make civilization, for the sake of which the United States is at war, the John Simon Guggenheim Memorial Foundation in its annual awards of fellowships has announced the addition of sixty-four fellows to its lists. However, it is recognized that no institution can or ought to try to escape the great urgencies of these times, and accordingly all fellows have been informed that the use of their fellowships is subject to any war work or military or naval duties to which they may be called; but should any recipient of a fellowship be called into service his fellowship will be held for him until the war has been won. The number of fellowships awarded this year is considerably less than the number awarded in recent previous years and the foundation is reserving a part of its funds for fellowships for those now in the war effort who doubtless, but for that circumstance, would have applied for and have been granted fellowships this year.

The theme which underlies the diversified list of fellowships granted this year is the theme of understanding the civilization in which we live and particularly the understanding of the Americas. A group of awards is in the field of philosophy, and these fellows are planning to work in the field of moral philosophy, attempting to gain understanding of the principles by which ethical judgments or judgments of human values are formed.

This is the eighteenth annual series of awards by the foundation, which was established and endowed by the late United States Senator Simon Guggenheim and by Mrs. Guggenheim as a memorial to their son John. The Guggenheim fellowships are granted to scientific workers, scholars, artists and creative workers in all fields who by their previous work have shown themselves possessed of unusual ability, demonstrated by the previous production of contributions to knowledge or by the production of works of art. Men and women, married and unmarried, of all races and creeds who are citizens or permanent residents of the United States, citizens of Canada and of certain Latin American countries are eligible on equal terms. The fellows are normally of ages between 25 and 40 years. The stipends are usually $2,500 a year. Since its establishment eighteen years ago, the foundation has granted 1,289 fellowships with stipends amounting to $2,662,000.

The fellowships now announced are granted to American and Canadian scholars and creative workers and are accompanied by stipends amounting to $140,000. A series of fellowships for Latin Americans will be granted in June. The list of fellowships now announced contains the names of eleven women. There

are no appointments in fields of the physical and mathematical sciences because all first-rate workers in these fields are needed for direct war work or for teaching to insure continuity in the supply of scholars in these fields. The list includes one Filipino poet, one Negro economist and one Chinese artist. Several of the fellows will work in Latin America and several in Canada, while the Canadian fellows will work in the United States. Fellowships awarded in the sciences are:

WILLIAM VOGT, associate director of the Division of Science and Education, Office of the Coordinator of Inter-American Affairs: Preparation of a book on Peru's guano birds, based on three years of study on the West Coast of South America, from Cabo Blanco to the Strait of Magellan, carried on when he was naturalist to the Peruvian Guano Administration.

DR. KENNETH EDWARD CASTER, assistant professor of geology in the University of Cincinnati: A field study of the Paleozoic strata of the Northern Andes in Colombia and adjacent Venezuela.

DR. EDGAR ANDERSON, professor of botany, Washington University, and geneticist, Missouri Botanical Garden, St. Louis: The genetics of Indian corn, in Mexico and the Southwestern United States.

DR. FLOYD ALONZO MCCLURE, on leave from his post as professor of economic botany, Lingnan University, Canton, China: A book on the Chinese bamboos.

DR. HENRY PAUL HANSEN, assistant professor of botany, Oregon State College: A study of Post-Pleistocene forest succession and climate in the Pacific Northwest, based on fossil pollen analyses of peat deposits and other types of lake sediments.

DR. E. LUCY BRAUN, associate professor of plant ecology, University of Cincinnati: Studies of the ecology and taxonomy of the deciduous forest.

DR. TILLY EDINGER, research associate in paleontology at the Museum of Comparative Zoology, Harvard University: A paleontological study of the tooth development in amphibians and reptiles, particularly primitive fossil types, with special reference to the history of dental succession in the evolutionary line leading from ancestral fishes to mammals.

JOHN FRANCIS HANSON, teaching fellow in entomology, Massachusetts State College, Amherst: A study of all genera and species of stoneflies in the United States.

DR. BARBARA S. BURKS, research associate in psychology, Columbia University: To gather materials for a book on the role of twins in the study of man, based on case studies of the development, life adjustment in maturity and environmental history of identical twins separated in infancy and reared apart.

DR. SOLOMON E. ASCH, assistant professor of psychology, Brooklyn College: To prepare a book on the formation and change of opinion and attitude, based upon experimental investigations.

The trustees of the foundation, in addition to Mrs. Guggenheim, are Francis H. Brownell, Carroll A. Wilson, Charles D. Hilles, Roger W. Straus, Charles Earl, John C. Emison, Medley G. B. Whelpley and Charles Merz.

The committee of selection consisted of Dr. Frank Aydelotte, director of the Institute for Advanced Study, *Chairman;* Dr. Florence R. Sabin, of the Rockefeller Institute for Medical Research; Professor Edwin Bidwell Wilson, of the Harvard University School of Public Health; Professor Linus Pauling, of the California Institute of Technology, and Professor Wallace Notestein, of Yale University.

The fellows chosen this year come from fifteen states and the Philippines and from two Canadian provinces. Forty-four fellows are members of the staffs of thirty educational institutions, while twenty are free-lance workers.

VISIT OF LATIN-AMERICAN ENGINEERS TO THE UNITED STATES

EIGHTEEN Latin-American engineers, representatives of fourteen countries, who are visiting Greater Boston, arrived on April 5 at Harvard University, one of the twenty-five universities and electrical establishments they plan to inspect during a year's visit to the United States. They are particularly interested in rural-electrification problems.

Dr. Francisco Castillo Najera, Mexican Ambassador to the United States, and Dr. Gonzalo Bautista, Governor of the State of Puebla, are leaders of the Mexican party. From April 5 to April 9 they were entertained by state and city officials, scientific societies and institutions and private individuals. Harvard Observatory arranged the program of entertainment in token of its interest in the new national astrophysical observatory at Tonantzintla, near Puebla. Dr. Luis Enrique Erro, director of the observatory; Señor Salvador Duhart M, first secretary of the Mexican Embassy; Dr. Carlos Graef, assistant director of the observatory, and Dr. Frederico Jiminez O'Farrill were among the visitors.

On Tuesday morning Major General Sherman Miles, commander of the First Service Command, called on the deputation at the Copley Plaza Hotel. During the morning the deputation visited Governor Saltonstall, President Conant, of Harvard University, and Mayor Tobin. The Mayor gave a luncheon in honor of the party and Governor Saltonstall was host at a tea in his home in the afternoon. Jerome Greene, secretary of the Harvard Corporation, was host at a dinner in the Tavern Club in the evening, after which a special meeting of the American Academy of Arts and Sciences was convened in tribute to the sponsorship by Governor Bautista of one of the most important observatories in Latin America, and in tribute to

the scientific accomplishments of the Mexican Ambassador. Dr. Harlow Shapley, director of the Harvard Observatory and president of the academy, presided. Ambassador Najera spoke on cultural relations between the United States and Mexico, and Dr. Kirtley F. Mather, professor of geology, discussed the earthquakes, volcanoes and mountain systems of Mexico. Members of the Pan-American Society of Massachusetts attended the meeting and the reception which followed.

Headquarters of the First Service Command, Harvard Observatory and the Harvard Medical School were visited on Wednesday morning. There was a reception at the Fogg Art Museum in the afternoon followed by a concert by the Harvard Glee Club and a tea given by the Harvard Corporation. Dr. Godfrey Cabot and Mr. and Mrs. Ralph Bradley gave a formal dinner in the evening. A visit to the Massachusetts Institute of Technology on Thursday morning preceded an inspection tour of Fort Devens, and was followed in the afternoon by a visit to the Harvard Oak Ridge Observatory and the Seismographic Station. After various private social functions the party attended a reception at Radio Station WRUL on Thursday evening at which the Governor and the Ambassador were interviewed for a shortwave broadcast in Spanish.

The official group leaves Boston on April 9 for Springfield, where it will be entertained before its departure for New York City. Dr. Bart J. Bok, of the Harvard Observatory, was in general charge of the arrangements.

SCIENTIFIC NOTES AND NEWS

THE New York Section of the American Chemical Society has awarded the Eli Lilly and Company Prize of $1,000 in biological chemistry for 1943 to Dr. Herbert E. Carter, of the University of Illinois.

DR. WILBUR A. SAWYER, of the International Health Division of the Rockefeller Foundation, was the guest of honor at an official reception held on March 26 by the City Council of Guayaquil, Ecuador. After the reception he laid the cornerstone for a statue of John D. Rockefeller being erected to mark Ecuador's gratitude for the eradication of yellow fever in 1919.

THE Herbert Jackson Prize for 1942 of the London Midland and Scottish Railway has been awarded to J. Dearden, of the Metallurgical Section of the Railway's Research Department, for papers entitled "The Inspection of Welded Steel Joints in Relation to Their Static Mechanical Strength," and "The Influence of Welding Defects on the Resistance to Fatigue of Welded Steel Joints."

DR. ROBERT A. BROTEMARKLE, professor of psychology and personnel officer of the college at the University of Pennsylvania, has been appointed director of the psychological laboratory and clinic and chairman of the department of psychology to succeed the late Dr. Edwin B. Twitmyer. Dr. Brotemarkle has resigned as personnel officer, a position which he has held in conjunction with his teaching activities since 1926. He has been connected with the department of psychology since 1919.

DR. PAUL F. BARTUNEK, instructor in physics at Rensselaer Polytechnic Institute, has been appointed assistant professor of physics at Allegheny College.

DR. WALDO L. SCHMITT, who has been engaged continuously in biological research under the Government since 1907 and as curator of marine invertebrates in the U. S. National Museum since 1920, has been selected to fill the position of head curator of biology made vacant by the death on February 28 of Dr. Leonhard Stejneger. Dr. Schmitt will assume his new work on his return from his trip to South America. Dr. Doris M. Cochran, since 1919 a member of the staff of the National Museum, since 1927 as assistant curator of reptiles and amphibians, has been named associate curator in charge of that division.

DR. LEWIS HILL WEED, professor of anatomy and director of the School of Medicine of the Johns Hopkins University, has been made chairman of the Medical and Health Advisory Committee of the American Red Cross.

H. H. ALP, associate professor of poultry extension at the University of Illinois, will serve during the emergency as senior poultry specialist with the Institute of Inter-American Affairs. It is expected that his headquarters will be at Rio de Janeiro, Brazil.

DR. RALPH H. MANLEY, formerly principal chemist and chief of the oil and protein division of the Northern Regional Research Laboratory, U. S. Department of Agriculture, has joined the research staff of General Mills, Inc. He will study the development of new industrial uses for vegetable oils and proteins and their derivatives.

JEROME SWIMMER, of Baltimore, has been appointed assistant toxicologist in the Medical Research Division of the Chemical Warfare Service at Edgewood Arsenal, Maryland.

DR. JAMES M. SPRAGUE has been appointed director of organic chemical research in the Medical Research Division of Sharp and Dohme, at Glenolden, Pa.

Since 1937 he has shared in the direction of organic research work in the organization. Under the new arrangement he will direct the program of these laboratories in the synthetic organic field.

F. W. NITARDY, vice-president of E. R. Squibb and Sons, has been elected vice-president and technical director of its newly formed subsidiary, E. R. Squibb and Sons Inter-American Corporation.

DR. MELVILLE SAHYUN, formerly director of biochemical research, has been appointed director of research for Frederick Stearns and Company of Detroit, Mich.

DR. JACK W. DUNLAP, who has leave of absence from the University of Rochester, has resigned as director of research of the Committee on Selection and Training of Aircraft Pilots of the National Research Council and has accepted a commission as Lieutenant Commander in the Navy. He is attached to the Aviation Psychology Section of the Bureau of Medicine and Surgery and is working on problems of selection of aviation personnel.

FELIX WEBSTER MCBRYDE, instructor in geography in the Ohio State University, has been appointed senior geographer in charge of the Latin American Field of the Military Intelligence Service, War Department, Washington, D. C.

DR. FLOYD S. MARKHAM, associate professor of bacteriology at the Ohio State University, has leave of absence. He has left Columbus for North Africa to take charge of laboratories for the Typhus Commission of the Rockefeller Foundation.

ABBE HENRI BREUIL, formerly professor of prehistoric ethnology at the Collège de France and director of exploration at the Institute of Prehistory, has gone to the Union of South Africa to conduct researches on the Rand for the duration of the war.

THE Jayne Memorial Lecture of the American Philosophical Society was delivered on March 31 by Dr. Detlev W. Bronk, Johnson professor of biophysics and director of the Johnson Foundation at the University of Pennsylvania. His subject was "Physical Machines and Physiological Mechanisms in Aviation."

DR. LOWELL T. COGGESHALL, of the School of Public Health of the University of Michigan, will deliver the Cutter Lecture on Preventive Medicine at the Harvard Medical School on April 27. His subject will be "The Importance of Tropical Diseases in the Current and Post-war Period."

PROFESSOR GUY-HAROLD SMITH, chairman of the department of geography of the Ohio State University, gave a series of lectures at the College of Commerce of the State University of Iowa on March 23 and 24. He spoke on "The Geographical Basis of Pan-Americanism," "Japan's Position in the Southwest Pacific," "Geopolitics, a New Design for the World" and "Cartography and the War."

MEDAL DAY of the Franklin Institute, Philadelphia, will be held on April 21. The date was incorrectly given in SCIENCE last week.

BY action of the Board of Trustees of the University of Illinois, the departments of zoology and physiology will be merged. Professor Carl G. Hartman, who has served as head of both departments for the past two years, will continue as head of the new department of zoology and physiology.

THE Rockefeller Foundation has for the third year in succession made a grant to the Royal Society, London, to enable it to give assistance to scientific societies and associations which, as a result of war conditions, are experiencing financial difficulties in the publication of scientific journals.

THE residue of the estate of Major Henry Reed Hatfield, Philadelphia, valued at $1,000,000, has been bequeathed, after the payment of $226,000 in specific bequests to charities, to the University of Pennsylvania and to Jefferson Medical College.

AN agreement has been concluded between the New York Botanical Garden and the American Society of Plant Taxonomists whereby *Brittonia*, a journal of plant taxonomy published by the garden, becomes an official organ of the society. Members of the society subscribe to *Brittonia* at a special rate and are accorded all privileges of publication in it. An editorial board has been appointed consisting of H. W. Rickett (for the New York Botanical Garden), Earl E. Sherff, C. A. Weatherby and S. F. Blake. *Brittonia* will be published, as heretofore, at irregular intervals; the first issue under the new arrangement is expected late this year.

THE University of Leeds has received a gift of £50,000 from Henry Ellison, to establish an endowment fund for the provision of post-graduate fellowships for research in pure and applied chemistry and in physics.

AN endowment by the late Frank Collins, of the National Supply Company, has made possible the erection of a new two-story building 136×95 feet to house the Toledo Hospital Institute of Medical Research. The institute consists of a staff including a biochemist, a nutritionist, a bacteriologist, a pathologist and a biophotographer under the direction of Dr. Bernhard Steinberg. The staff will be augmented in the future by a physiologist, a biophysicist and a pharmacologist. Provision has been made to accept fellows in medical and dental research. It is the pur-

pose of the institute not to devote itself exclusively to the study of a single disease, but to maintain a fluid interest in disease in general depending upon the availability of the specific personnel.

THE late Dr. Robert Boyd, formerly chairman of the Manchester Division of the British Medical Association, made a bequest to the association for the benefit of his professional colleagues in the Manchester area. The gross value of his estate is in the region of £100,000. Subject to certain life interests, the residue is left to the British Medical Association to be applied to capital as well as income for the purpose of endowing or contributing to the endowment of a British Medical Association House in the district of Manchester for the benefit and use of all qualified and registered doctors. The power of making regulations for the conduct and use of the house are vested in the Governing Committee for the time being of the Manchester Division of the association.

The Lancet states that the Rockefeller Foundation has given £1,200 to the University of Oxford for biochemical investigations of penicillin under the direction of Dr. H. W. Florey, professor of pathology. The foundation has made a further grant of £3,500 towards the initial equipment of the nutritional survey.

THE Langley Porter Clinic of the Medical School of the University of California, San Francisco, was opened on February 13. The outpatient department was named in honor of the late Dr. Aaron J. Rosanoff, who was largely responsible for the building of the clinic. At the time of his death he was director of the California State Department of Institutions.

ACCORDING to *Museum News*, the California Academy of Sciences, San Francisco, includes in its future plans the erection of a new wing to the African Hall and an Alice Eastwood Herbarium to house the more than 300,000 specimens collected by her during a long career as curator of the department of botany.

To meet the growing importance of physics in industrial research, the central chemical laboratories of the Hercules Powder Company, as announced by Dr. Emil Ott, director of research, has formed a separate technical group to coordinate and develop physics work. Research by the new group at the Experiment Station, of which Dr. Robert W. Cairns is director, will emphasize electrons and optics, using such equipment as the electron microscope, mass spectrograph, x-ray diffraction cameras for crystal structure analysis and spectrographs for a complete range of light-absorption studies not limited to the visible spectrum but ranging from ultraviolet to infra-red. Dr. Willard P. Connor, Jr., formerly research associate at Princeton University, will be acting leader of the physics group.

THE *Bulletin* of the Institute of International Education writes: "The announcement was made by the Department of State on December 29, 1942, that awards of official scholarships, fellowships and travel or maintenance grants to United States students for study in the other American republics from Department of State funds were being suspended for the duration of the war. The suspension does not affect grants made before that date. In his announcement the Secretary of State emphasized that the United States Government had no thought of discontinuing the award of fellowships and travel and maintenance grants to citizens of the other American republics for study in the United States. On the contrary, he expressed the hope that the situation in other American countries would permit the continuance of the program for their students to come here under the Convention for the Promotion of Inter-American Cultural Relations. The announcement referred in every case to United States 'students' assisted by the Department of State and made no mention of any change in the procedure in regard to teachers or professors."

IT is reported in *Nature* that the People's Commissar for Education in the U.S.S.R. has instituted fifteen valuable Newton scholarships for Soviet university students. They are to be awarded to young men and women specializing in physics, mathematics, mechanics and astronomy. The Universities of Leningrad and Moscow will receive three scholarships each. Other Newton celebrations include exhibitions of portraits and books on Newton in English, Russian and other languages at the University of Moscow and the Scientists' Club.

THE latest information regarding the issue of new and revised British Standards, of which there are at present over a thousand, can be obtained from the library of the British Standards Institution, 28, Victoria Street, Westminster, London.

DISCUSSION

CAMEL, HORSE AND BISON ASSOCIATED WITH HUMAN BURIALS AND ARTIFACTS NEAR FRESNO, CALIFORNIA

BONES of *Camelops, Equus* and *Bison* have been found in association suggesting contemporaneity with Indian burials and artifacts on the open plain of the central San Joaquin Valley near Tranquillity, Fresno County, Calif.[1] The site lies in an old alluvial soil, fourteen miles east of the Diablo Range foothills, and

about thirty miles west of the Sierra Nevada foothills. Conditions at the site strongly suggest that the carcasses of the now extinct mammals were brought there by hunters of the group which built fires, buried its dead and made the numerous stone and bone artifacts which have been found in the deposit. The bones of the American camel, horse and bison occur along with bones of species still living in the San Joaquin Valley, broken in a manner characteristic of kitchen refuse, along with artifacts and in the vicinity of burials.

All bone on the site, whether human (four individuals were still wholly or partly articulated in a semi-flexed position), of animals, both extinct and modern, or of the numerous bone awls and other implements, is very heavily mineralized, with about twice the specific weight of ordinary dry bone and with greatly increased hardness. Out of more than 100 San Joaquin Valley archeological sites investigated by W. Massey, G. Schmidt and the writer in 1939, the Tranquillity site was the only one on which such mineralized bone occurred.[2] It was the condition of the bone which prompted further work, rather than the identification of the extinct species, which was not completed until this year (1942).

Faunal remains include two extinct species: *Camelops sp.*—mandibles, teeth, astragalus; *Equus sp.* (presumably the extinct American horse)—several teeth *Bison sp.* (not necessarily an extinct species, but unknown in the local fauna in historical times) is represented only by a tooth and orbital fragment. In addition, there was much unidentifiable fragmentary long-bone material on the site which seemed too large for any but the foregoing animals. Other forms are still surviving species: pocket gopher, badger, coyote, fox, jackrabbit, dwarf elk, antelope and salmon.[3]

Artifacts include a wide range of chert and obsidian point types, scrapers, blades and a drill; metate, mano (the latter very abundant); pestles, and mortar fragments (few); side-notched net-sinkers; grooved end stone (a possible "Charmstone"); two steatite sherds; asphaltum lumps; much burnt clay, some with stick, reed and mat impressions; bone awls, points and spatulate objects, all heavily mineralized; 56 obliquely lopped-end *Olivella* shell beads, associated with the burials, and a miscellany of broken stones of various kinds, none obtainable from the immediate neighborhood. The artifacts, while generically "Californian," are not like those of any recent archeological culture from the Central San Joaquin area, though they are similar to those from certain "early" cultural complexes described from elsewhere in the state.

In the light of finds from other parts of the continent, the occurrence of the extinct *Camelops* along with horse and bison in an archeological site is not surprising.[4] What makes the site especially interesting are the human burials, which seem to belong to the same horizon as the artifacts and extinct animals. If further work on the Tranquillity site were to establish the contemporaneity of the skeletal materials beyond question, we could determine the physical type of an early Indian population in North America for which there has been so far a great paucity of skeletal data. The writer hopes that a more detailed description of the site and its materials may be published, as there is little likelihood of further work on the site until after the war.

GORDON W. HEWES

WASHINGTON, D. C.

PURE NATURAL NITROGEN GAS[1]

REFERENCE by Science Service on January 1, 1943, to an earlier account of the finding of pure nitrogen gas in a well as one of the notable discoveries of the year is misleading and the subject is perhaps worthy of brief comment. In SCIENCE of February 27, 1942, Mr. Harold J. Cook reports that 100 per cent. pure nitrogen gas was found at a depth of only 156 feet in a well drilled on the W. H. Cross ranch near the southern rim of the Powder River Basin, Wyoming. The gas is said to have developed a rock pressure of 11 pounds in 10 minutes and it is suggested that because of its purity the gas may have value in the present war emergency.

High-percentage natural nitrogen gas wells have been known for many years and are particularly common in the Permian Basin of Texas and New Mexico. Here nitrogen gas may be confined under pressures as high as 1,500 to 2,000 pounds per square inch. Analyses of some of these gases show them to contain

[1] The collections from the Tranquillity site are now in the University of California Museum of Anthropology, Berkeley.

[2] Gordon W. Hewes, *American Antiquity*, 7: 123–33, 1941.

[3] Faunal remains secured in the early work on the site were identified by Dr. Chester Stock, California Institute of Technology, Pasadena, as elk, bison, gopher, *Canis* sp., and camelid. Dr. Stock hesitated to identify generically on the basis of a single Camelid astragalus. Later and fuller collections, including mandible material, enabled Drs. Stirton, Vanderhoof, Camp and Wells, Department of Paleontology, University of California, to identify the camelid as *Camelops* sp. The later collection also included *Equus* teeth and badger bones, not present in the material sent to Dr. Stock.

[4] See the papers by F. H. H. Roberts, Jr., and Julian Steward in "Essays in Historical Anthropology of North America," *Smithsonian Institution, Miscellaneous Collections*, vol. 100, 1940.

[1] Published by permission of the Director, Geological Survey, U. S. Department of the Interior.

from 97 to 99 per cent. of nitrogen. When a 7- or 8-inch drill penetrates a high-pressure gas pocket the gas issues with a roar that can be heard a mile or more away and the well may continue to blow for a period lasting from a day to two weeks before the pressure is sufficiently reduced to permit resumption of drilling. The initial gas flow of large wells may reach 50,000,000 cubic feet per day from a reservoir having a possible total storage capacity of one half to one billion cubic feet of nitrogen gas. Most of these nitrogen gas pockets, however, are small and many are exhausted by open flow in a day or two.

The writer has observed that large accumulations of nitrogen gas may be confined in rocks which are related to basins of saline or brackish-water deposition. The rock minerals more commonly associated with nitrogen gas in the Permian Basin are halite, anhydrite and dolomite. Pockets of nitrogen gas are most common in the Salado formation of the Permian Basin. Though they are encountered less often in drilling through the Chalk Bluff formation, which underlies the Salado, the reservoirs are usually larger and their gas pressures higher because of their lower stratigraphic position and greater depth. In the Amarillo area nitrogen gas occurs still lower in the Permian section.

Nitrogen gas accumulations indigenous to sedimentary rocks are likely to be due either to a generation of the gas by chemical reactions occurring within the sediments or by the abstraction of oxygen from air entrapped with the sediments during deposition. The question of origin of the gas involves more discussion than can be offered here. Some oxygen is reported in most of the analyses of high nitrogen gases, which suggests that the nitrogen gas of the Permian Basin may be air from which most of the oxygen has been removed.

The critical evidence to support this hypothesis is not now available. Unfortunately, the routine cryogenic analysis does not determine and report the presence of argon or the other inert gases krypton, xenon and neon. Helium is reported for special investigations only. If any of these inert gases is present it appears in the report as nitrogen. Thus no natural nitrogen gas can be considered pure unless assurance is given that no appreciable quantities of the other inert gases are present with the nitrogen. Air contains about 1 per cent. of argon and if oxygen is removed argon will make about $1\frac{1}{4}$ per cent. of the remaining gases. If the gases of the Permian Basin that contain 98 per cent. of nitrogen are found upon analysis to have about 1 per cent. of argon, the evidence will be fairly conclusive that these gases were derived from the atmosphere.

Nitrogen gas formerly considered worthless is becoming useful in industry. The atmosphere, which is about 75 per cent. nitrogen, provides a universal, inexhaustible supply of this gas for the manufacture of acids and fertilizers. Nitrogen is now employed with argon in making electric lamps. Both gases are refined separately and then used for a specific purpose in lamp manufacture. Nitrogen from gas wells could be used as a substitute for carbon dioxide to smother enclosed fires which do not require a heavy gas, for quenching fires in the fuselages and motor nacelles of airplanes and for inflating rubber boats.

WALTER B. LANG

U. S. GEOLOGICAL SURVEY

FRANZ BOAS, PSYCHOLOGIST

IN their appreciations of Franz Boas, Benedict[1] and Lowie[2,3] have discussed his professional career, beginning with his early training in physics, geography and mathematics and culminating in his pioneer contributions to physical and cultural anthropology, linguistics and ethnology. Proper emphasis, however, has not been given to the fact that toward the end of his career, Boas became increasingly interested in *psychological* problems. In fact his chief interest seems to have shifted from the anthropological description and intercomparison of cultures *per se* to the psychological description of the specific stimulating conditions under which the individual's responses are acquired. The various investigations of motor behavior carried out by his research associates, covering such studies as those on posture, walking, speed of tapping and gesture, serve to illustrate this interest in experimental social psychology. That Boas maintained an interest in this field to the end is attested by his last letter to the writer, written four weeks before his death, in which he discussed certain methodological considerations in connection with a proposed study of bodily movements accompanying speech in the American Negro.

As more and more data were accumulated, Boas became increasingly certain of his position in explaining the individual's behavior in terms of his previous stimulation and resulting reactional biography rather than in terms of such typological constructs as "race." It is in this area of the social conditioning of behavior that one appreciates Boas's interest in psychological theory, and certainly here one must disagree with Lowie[2] and find Boas more than "a faithful, intelligent collector of raw detail." Experimental social psychology has lost one of its ablest students in his death.

JOHN P. FOLEY, JR.

THE GEORGE WASHINGTON UNIVERSITY

[1] R. Benedict, SCIENCE, 97: 2507, 60–62, 1943.
[2] R. H. Lowie, *Scientific Monthly*, February, 1943, pp. 183–184.
[3] R. H. Lowie, SCIENCE, 97: 2513, 202–203, 1943.

QUOTATIONS

"NATURE" AND THE MACMILLAN COMPANY

THE idea of a weekly journal of science began in 1868 with discussions between Sir Norman Lockyer, the astronomer and spectroscopist, and his friends, among whom were Alexander Macmillan. Lockyer was assured of the support of T. H. Huxley, Tyndall and practically all the other leading workers in science of the time. Alexander Macmillan enlisted the support of Sir Joseph Hooker and other of his scientific friends; but much of the initial success was due to Alexander Macmillan himself, of whom Sir Norman Lockyer once wrote:

> It was in consequence of his sympathy and enthusiastic assistance that the journal started. He was unwavering in his support of the belief that British science would be advanced by a periodical devoted to its interest. . . . It was the hope that a more favorable condition for the advancement of science might be thereby secured that led Mr. Alexander Macmillan to enter warmly into the establishment of *Nature* in 1869.

In this connection we might quote part of a letter written by Alexander Macmillan to Sir William Thomson (afterwards Lord Kelvin):

> Lockyer is going to start a weekly Journal of Science, which we are to publish. It is meant to be popular in part, but also sound, and part devoted specifically to scientific men and their intercourse with each other. Huxley, Balfour Stewart, Wilkinson, Tyndall, Roscoe and almost every one who is about London have given him their names, and he very greatly wishes yours, as among those who promise support. May I tell him you consent?

The launching of *Nature* is chronicled in a letter to the Glasgow bookseller, MacLehose, written on November 3, 1869:

> *Nature* is to be published on Thursday in London at 2.30. . . . Lockyer was peremptory that our publication day should indicate the point to which our information is brought up. The fallacy of a Saturday publication with a Thursday actual information he does not think right. . . . We start with 18 pp. of advertisements. . . . I think it will look nice.

In the complete context of this letter it is worth noting that Sir Norman Lockyer had an absolutely free hand in reviewing books published by the firm of Macmillan itself, and never hesitated to criticize them adversely if he thought they deserved it. This absolute and complete freedom of policy has been extended to the editors of *Nature* from that day to this.

In 1919, Sir Richard Gregory succeeded Sir Norman Lockyer in the editorial chair of *Nature*. During his long period of editorship the journal made considerable progress, and its influence in the world of science has gradually become stronger and more secure. To-day it is the leading journal of science. In 1938, Sir Richard Gregory was succeeded jointly by A. J. V. Gale and L. J. F. Brimble. The extent to which *Nature* has now grown, not only in scientific but also sociological influence, must be left to the opinion of its readers.

One thing, however, we think that readers of *Nature* should know is the great debt which they owe to the publishers. *Nature* was initially launched and is still being published almost solely for the advancement of science, in spite of the fact that it is privately owned by a business firm. The present editors feel impelled to put on record their gratitude to the present directors of the House of Macmillan for the entirely free hand given them in guiding the policy of *Nature* and in deciding what shall and what shall not be published. To-day, as much as ever, if *Nature* feels that in the interests of science and culture, any book, whether published by Macmillans or not, should receive adverse criticism, then it gets it. If *Nature* desires to follow a certain policy where science is concerned, whether it be against or in support of other authorities, even the Government, then her policy is pursued relentlessly, yet, we hope, with tolerance. The directors never interfere with policy. Rather do they encourage the journal in all manner of ways, some of which have not received the recognition in the past that they deserved. In fact, it is quite possible that had the former directors not been prepared in the interests of scientific development to publish *Nature* for several decades at a financial loss, *Nature,* as we now know it, might not be in existence.

To-day, financial problems do not exist, and the considerable help given during the present very difficult times (especially of paper shortage and other exigencies of war) by the directors and their staffs certainly relieve the present editors of a considerable amount of care, and thus contribute in no small way towards the advancement of science in general and the success of *Nature* in particular.—*Nature.*

SCIENTIFIC BOOKS

ZOOLOGY

Osteology and Myology of the California River Otter. By EDNA M. FISCHER. Stanford University Press. 1942. 66 pp. 37 figures. $1.50.

Here is a brief description of this animal in preparation for a comparative study of the sea otter. It is an offset publication and excellently done.

The Ivory-billed Woodpecker. Research Report Num-

ber 1 of the National Audubon Society, New York. 111 pp. 20 plates. 22 figures. 1942. $2.50.

We find here an interesting account of the ecology and natural history of a bird threatened with extinction. It is by a graduate student and represents an effort to devise means for the preservation of the species. It is very full and detailed and ends with a series of recommendations to improve the conditions under which the bird will have to live.

The Oceanic Tintinnoina of the Plankton Gathered during the Last Cruise of the Carnegie. By ARTHUR SHAKLETON CAMPBELL. Carnegie Institution of Washington Publication 537. 163 pp. 128 figures. 1942. $1.50.

This is an extended account of a group of ciliate Protozoa, including discussions of 13 subfamilies, 44 genera and 311 species. Of these there are 3 new subfamilies, 2 new genera and 14 new species. They were collected at 160 stations on the Pacific and Atlantic Oceans. Four general regions are recognized.

The Heterodontid Sharks: Their Natural History and the External Development of Heterodontis japonicus Based on Notes and Drawings by Bashford Dean. By BERTRAM G. SMITH. The Bashford Dean Memorial Volume Archaic Fishes. New York. 649–770 pp. 7 plates. 70 text figures. 1942. $5.00.

In this volume is found some of the results reached by Dean in his studies of these fish. There is first a comparison of the various species, followed by an account of habits and development. Only a small part of the work is by Dean. The drawings are attributed to him, although it is stated that some of them were done by Yatsu. While it is evidently desirable to retain Dean's connection with this work it is perhaps unfortunate that the material could not be treated unreservedly. Still, it is a useful piece of work well presented, and it is only to be regretted that Dean's original idea of comparison could not be fully carried out.

The Copepods of the Plankton Gathered during the Last Cruise of the Carnegie. By CHARLES B. WILSON. Carnegie Institution of Washington Publication 536. 237 pp. 1942. $2.50.

There are given here the results of an extensive series of collections, made at three levels of the ocean and at 162 stations. A long line of species is studied in their relation to temperature, salinity, hydrogen ion concentration and light. There is first listed the species at each individual station, followed by a detailed consideration of each species. From these we learn that the Pacific plankton is much the richer. Also that in distribution there is horizontally no uniformity and that vertically the species are stratified. According to temperature the concentration was greater at the lower, cooler levels. Salinity and hydrogen ion concentration have little effect on distribution of animals. On the other hand light is a direct cause of vertical stratification.

C. E. MCCLUNG

DEPARTMENT OF ZOOLOGY,
SWARTHMORE COLLEGE

CHEMICAL AND PHARMACEUTICAL COMPOUNDS

Preparacion de Productos Quimicos y Quimico-Farmaceuticos. By C. A. ROJAHN and F. GIRAL. 2 volumes. 1002 pp. Published by Editorial Atlante, Mexico, D. F., Mexico.

DR. C. A. ROJAHN, director of the School of Pharmacy and of the Institute of Food Chemistry in the University of Halle, had published in German reviews of pharmacy and pharmaceutical chemistry for some years a series of articles on the preparation of chemical and pharmaceutical compounds. These articles were completed and published in book form in 1937. Dr. F. Giral, a young Spanish professor of organic chemistry, now residing in Mexico, has translated the original German book into Spanish and increased its value by adding to it 120 compounds, among which are some war gases, lead tetraethylate, sulfanilamide and prontosil, ergosterine, nicotinic acid and digitoxin. The book describes the preparation of 718 compounds, of which 217 are inorganic and 501 organic. It includes the most important industrial and pharmaceutical chemicals and among them the most important aliphatic, aromatic, hydroaromatic, heterocyclic compounds, dyes, alkaloids and glycosides. The author gives for each compound the following details: formula and molecular weight, raw materials and equipment necessary for its preparation, method, chemical reactions involved, yield, properties, assay and bibliography. The methods of preparation are described in such a way that they can be very easily followed by the student. The style is certainly not meant for the highly specialized chemist.

The book is essentially practical and will be found useful by students of chemistry and pharmaceutical chemistry and by the pharmaceutical concerns of the Latin American countries.

RAFAEL MENDEZ

DEPARTMENT OF PHARMACOLOGY,
HARVARD MEDICAL SCHOOL

REPORTS

DOCTORATES IN SCIENCE

For many years Dr. Clarence J. West, then of the National Research Council, edited an annual list of doctoral dissertations in the various fields of the sciences, most of which lists were published in the *Reprint and Circular Series* of that council.[1] During the 1933–34 academic year the National Research Council, the Social Science Research Council and the American Council of Learned Societies agreed to join in providing subsidies to the Association of Research Libraries in order to enable it to publish a complete list of all doctoral dissertations accepted in the United States and Canada each year. Dr. West generously surrendered his series to Mr. Donald Gilchrist, who began the new series under the title "Doctoral Dissertations Accepted by American Universities."[2] Mr. Gilchrist died suddenly, from a heart attack, just as No. 6 was going to press. The present writer was elected editor in December, 1939, and has edited three annuals bringing the series to nine.

The editor of Science has asked him to prepare this report regarding dissertations in the sciences. It is a study of what the nine annual volumes group as five physical sciences, seven earth sciences, fourteen biological sciences and anthropology, which is included here because it appeared in Dr. West's list of sciences and also because it is on the border line between the biological and the social sciences.

Table I herewith shows these twenty-seven fields of science arranged in order of the total number of dissertations accepted in the last nine years in each field. This table is unfair to just one field—biochemistry. In only five years it has attained eighth place in the table though all other totals cover nine years. If all the sciences were ranked on the basis of the last five years only, biochemistry would be in third place, well above psychology. And this leads to a word of caution to any one who would draw conclusions from this table. In general, the editor enters the dissertations under the particular science specified by the university reporting. Many institutions report many theses under "agriculture," which might well be classified in such fields as horticulture, entomology, etc. We allow the institutional designation to stand. In like manner, several dissertations which are obviously entomology were reported as "zoology." We allowed that to stand. However several institutions report blocks of dissertations as, "biology." The editor is forced to classify these on the basis of his understanding of the titles. Further, there are several overlapping fields such as geology and paleontology; anatomy, physiology and medicine and surgery. Different institutions vary in their classification of dis-

TABLE I

Doctoral Dissertations Accepted in the Sciences

Rank	1934	1935	1936	1937	1938	1939	1940	1941	1942	Totals
1 Chemistry	500	470	482	497	426	482	527	672	588	4644
2 Physics	121	150	147	158	148	165	148	191	146	1374
3 Psychology	104	101	118	112	108	123	120	117	125	1028
4 Zoology	111	113	132	98	102	102	112	125	110	1005
5 Botany	117	110	108	88	106	108	112	102	120	971
6 Mathematics	82	77	84	76	62	91	103	95	85	755
7 Physiology	68	76	83	103	66	59	70	77	66	668
8 Biochemistry*	...	...	...	...	101	127	130	116	138	612
9 Engineering	97	63	48	70	59	44	77	76	47	581
10 Agriculture	62	77	53	48	37	40	58	78	55	508
11 Geology	55	62	64	42	58	49	55	53	56	494
12 Bacteriology and Microbiology	51	38	41	46	40	56	59	71	69	471
13 Entomology	34	34	30	51	33	47	48	46	44	367
14 Genetics	16	10	21	13	31	32	26	31	23	203
15 Pharmacology	15	10	18	14	19	23	23	31	31	184
16 Horticulture	9	24	14	21	16	11	20	23	21	159
17 Anatomy	10	25	15	14	20	17	21	18	16	156
18 Anthropology	10	13	20	15	18	11	26	19	14	146
19 Geography	17	15	8	13	13	17	18	16	16	133
20 Public Health	10	4	13	9	15	8	15	15	14	103
21 Metallurgy	13	11	16	7	7	9	11	17	11	102
22 Medicine and Surgery	18	14	12	1	7	9	10	13	15	99
23 Paleontology	8	12	10	8	9	13	11	11	6	88
24 Astronomy	11	11	5	9	12	5	6	11	7	77
25 Mineralogy	6	1	5	3	5	1	4	3	6	34
26 Meteorology	2	1	0	1	4	2	0	1	3	14
27 Seismology	3	2	0	0	0	0	2	1	1	9
Totals	1,550	1,524	1,547	1,517	1,522	1,651	1,812	2,029	1,833	14,985

* Biochemistry was introduced into our tabulations as a separate science in 1938. Before that date all biochemistry dissertations were grouped with chemistry.

[1] For a complete list of these reports, see "Doctoral Dissertations Accepted by American Universities," No. 1, 1933–34, p. iii.

[2] No. 1, 1933–34 (N. Y., H. W. Wilson Co., 1934).

TABLE II

NUMBER OF DOCTORAL DISSERTATIONS ACCEPTED

Rank		1942	Totals
1	Chicago	114	799
2	Wisconsin	97	795
3	Cornell	82	769
4	Michigan	66	685
5	Illinois	79	684
6	Columbia	74	684
7	California	88	649
8	Minnesota	86	619
9	Ohio	75	586
10	Harvard	58	534
11	Mass. Inst. Tech.	59	502
12	Yale	52	471
13	Iowa St. Coll.	60	454
14	Iowa	53	446
15	Johns Hopkins	43	411
16	New York	38	307
17	Calif. Inst. Tech.	28	266
18	McGill	36	257
19	Princeton	21	248
20	Toronto	26	243
21	Northwestern	27	231
22	Penn. St. Coll.	29	227
23	Pennsylvania	37	222
24	Stanford	24	214
25	Purdue	41	206
26	Maryland	28	175
27	Pittsburgh	23	160
28	Texas	19	146
29	Washington (Seattle)	11	145
30	Duke	14	136
31	Virginia	11	133
32	Brown	17	124
33	Nebraska	19	121
34	Indiana	16	121
35	Missouri	11	115
36	Cincinnati	11	114
37	Rochester	13	109
38	North Carolina	18	108
39	Rutgers	16	104
40	Catholic	22	101
41	Colorado	12	96
42	Western Reserve	8	86
43	Michigan St. Coll.	8	83
44	Kansas	3	82
45	Notre Dame	12	78
46	Washington (St. Louis)	9	75
47	Clark	10	64
48	Southern California	9	63
49	Lawrence (Inst. Paper Chem.)	8	60
50	Fordham	7	52
51	Rensselaer	5	50
52	Massachusetts	6	48
53	Louisiana	6	46
54	St. Louis	6	44
55	Boston	3	40
56	Rice	3	39
57	Florida	5	38
58	Carnegie Tech.	6	35
59	Brooklyn Polytech.	10	34
60	George Washington	2	34
61	Syracuse	0	34
62	Bryn Mawr	7	33
63	Radcliffe	5	33
64	Oregon St. Coll.	6	32
65	George Peabody	4	32
66	West Virginia	3	32
67	Georgetown	1	25
68	Kentucky	2	22
69	Washington St. Coll.	0	22
70	Vanderbilt	1	19
71	Tulane	3	16
72	Oklahoma	1	16
73	Kansas St. Coll.	6	15
74	Arizona	1	15
75	California (L. A.)	7	14
76	American	0	12
77	Colorado Mines	0	9
78	Marquette	1	8
79	Oregon	1	4
80	North Dakota	0	4
81	Temple	2	3
82	Hartford	1	2
83	Niagara	0	2
84	Tennessee	0	2
85	Smith	0	1
86	Georgia	0	1
87	Dropsie	1	1
88	Loyola (Chicago)	0	1
		1,833	14,985

sertations in physical chemistry, also in mathematical physics.

Table II shows from whence came these 14,985 dissertations in the sciences. It shows eighty-eight institutions which have accepted such dissertations arranged in order of the total numbers accepted by each in the last nine years. Some, such as Tennessee, no longer grant any doctorates. Others, like Hartford and Dropsie, are primarily theological but appear here because of one or more dissertations in psychology or in anthropology.

The order would be quite different if doctorates in the social sciences and the humanities were included. Space forbids the printing of the entire table showing the number of dissertations accepted in each subject each year. That number does not vary much from year to year, so we show only the numbers accepted in 1942 and the totals for the nine years.

Table III is not complete. The figures shown are the number of different fields of science in which each accepted one or more dissertations in each year. It is arranged by averages for the nine years and shows only those eighteen institutions which accepted dissertations in an average of approximately ten different sciences each year. These figures are interesting only upon the assumption that the various institutions have strong faculties in the various scientific fields in which they accept doctoral dissertations. In the cases of the schools omitted from Table III, the number of fields is so small and varies so much that the figures have no significance.

It is interesting to observe in Table III how great state universities outrank Chicago, Columbia, Yale, Harvard and Johns Hopkins in the number of science fields in which they accept doctoral dissertations. This would not be true if the social science and the humanities fields were included in the tabulations. It is also interesting to observe how close the University

TABLE III

NUMBER OF DIFFERENT SCIENCES IN WHICH DOCTORAL DISSERTATIONS WERE ACCEPTED

		1934	1935	1936	1937	1938	1939	1940	1941	1942	Average
1	California	16	17	15	15	17	15	20	21	18	17+
2	Michigan	16	16	16	16	18	16	18	17	19	17−
3	Wisconsin	14	14	16	15	16	19	16	18	19	16+
4	Minnesota	17	14	13	16	15	17	19	17	17	16+
5	Cornell	13	12	15	15	18	17	17	17	16	16−
6	Chicago	15	15	13	14	15	15	16	16	16	15
7	Columbia	13	12	12	16	14	14	18	15	13	14+
8	Yale	13	16	12	12	14	15	14	14	16	14
9	Illinois	15	13	13	14	12	15	14	16	12	14−
10	Ohio	14	10	12	12	12	12	13	17	14	13−
11	Harvard	13	11	11	13	12	13	12	10	14	12+
12	Johns Hopkins	13	9	9	12	14	15	11	9	12	12−
13	Iowa	11	9	10	12	12	10	12	11	13	11+
14	Iowa St. Coll.	8	10	11	11	10	13	12	13	12	11+
15	Toronto	11	8	10	12	8	11	13	13	7	10+
16	New York	9	10	8	8	9	11	13	9	13	10
17	Pennsylvania	9	10	10	11	9	9	12	11	9	10
18	Stanford	8	8	12	9	10	11	9	12	9	10−

of Iowa and Iowa State College stand in both Table II and Table III, while Pennsylvania State and Michigan State with an average of about five fields each per year are so far behind their respective state universities that they are excluded from Table III.

Perhaps the most interesting observation from all the tables is that of the entire 14,985 dissertations almost one third were written in the field of chemistry, or well over one third if we include those in biochemistry. Another observation is that well over one third of all the dissertations (5,684 out of 14,985) were accepted by the first eight institutions in Table No. II. Verily we are in an age of chemistry which is dominated by a few great universities.

Any one interested in seeing the titles of these dissertations should consult a file of the nine annuals. These titles reveal the particular lines along which research is being pressed to-day.

EDWARD A. HENRY
UNIVERSITY OF CINCINNATI

SPECIAL ARTICLES

THE INTEGRATION OF GENETIC AND EPIDEMIOLOGICAL METHODS OF ANALYSIS IN RHEUMATIC FEVER[1,2,3]

IN previous genetic and epidemiological studies of a series of rheumatic families, it was concluded that hereditary factors are primarily responsible for the familial concentration of rheumatic fever. It was postulated that genetic susceptibility for rheumatic fever is transmitted as a single autosomal recessive gene. It was also indicated that age susceptibility must be considered in the study of the familial epidemiology of rheumatic fever.[4,5]

In order to analyze the interaction of the genetic and epidemiological aspects of rheumatic fever, analytical techniques were developed which permit a numerical description of the sequence of events in a group of rheumatic families.

In classical genetic analysis, the final number of cases is estimated by the application of appropriate genetic formulae. In this study, the methods were extended by predicting the final number of cases in the families prior to the time when all the children present who could eventually become cases had an opportunity to be realized. Such a prediction represents an average estimate of the number of genetic susceptibles present in the families at the time of analysis.

This procedure permits the expression in numerical terms of the genetic risk for a group of families, an individual family, or for members within a family group at any time during their life experience. Within a family, the genetic risk or factor may be divided equally among all siblings, or apportioned unequally with respect to any specific variable such as age, sex or exposure.

It is obvious that in rheumatic fever, where the peak age of onset in children occurs at about 6 years of age, the current age risk for a two-year-old child or a twelve-year-old child is less than that for his six-year-old sibling. In order to apportion the genetic risk with respect to this age risk, a numerical measure of the age expression of rheumatic fever was obtained.

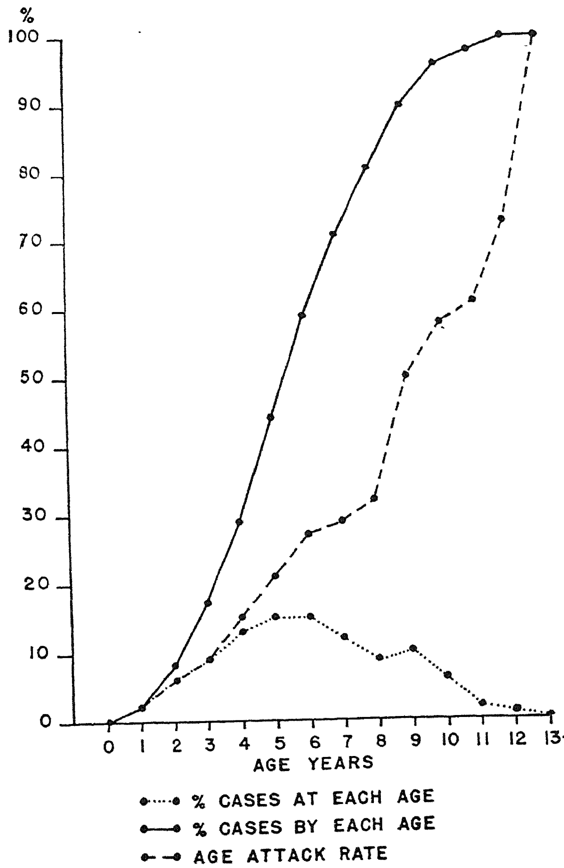

FIG. 1. Age factors derived from a rheumatic series of 688 case onsets.

[1] From the New York Hospital and the Department of Pediatrics, Cornell University Medical College.

[2] This work was aided by a special grant from the Commonwealth Fund.

[3] We gratefully acknowledge our indebtedness to Dr. Lowell J. Reed for his continued interest and constructive criticism during the progress of these studies.

[4] M. G. Wilson and M. D. Schweitzer, *Jour. Clin. Invest.*, 16: 555, 1937.

[5] M. G. Wilson, "Rheumatic Fever." New York: The Commonwealth Fund, 1940. Chapter III, pp. 21–65.

From an independent series of 688 rheumatic children whose onsets occurred between the ages of 2 and 13 years, several standard expressions of case incidence were derived which were found valid by analysis for defining the age risk under various circumstances (Fig. 1).

Using age and genetic factors in combination, it was possible to estimate the number of case onsets expected at various times during the life experience of a group of 109 rheumatic families, including 456 rheumatic and non-rheumatic siblings.

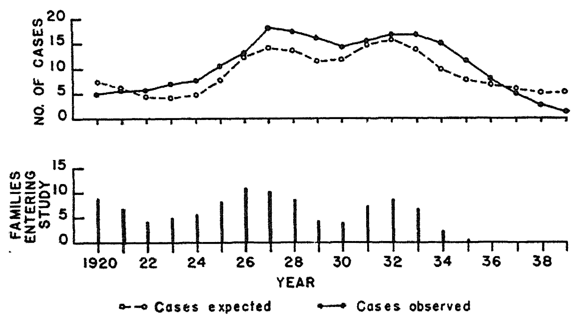

FIG. 2. Annual incidence of cases expected and observed during a twenty-year period, 1920–1939, in 102 rheumatic families.

The annual incidence of case onsets over a period of twenty years from 1920 to 1939 was estimated. Good agreement was obtained between expectation and observation (Fig. 2). It is apparent that in each year the total number of individuals defined by this procedure as genetic susceptibles of a susceptible age were realized as cases.

The general procedure was to assign to each sibling an equal fraction of the total final genetic expectancy for his family, correcting this for age in each calendar year using the cumulated age factor. Siblings were entered from the calendar year in which the families first came under observation. Siblings born subsequent to this year were entered at birth. In order to obtain the number of cases expected in any year, the total cumulated expectancy for the year preceding was subtracted from that of the current year, giving the annual expectancy. Case onsets were treated similarly.

In a communicable disease the occurrence and distribution of primary and secondary cases in a family is of epidemiological significance. The primary case in the family is frequently a source of exposure for other members of the household. Some observers have suggested that in rheumatic fever an active case constitutes a risk for the other siblings in the family.[6, 7]

When age and genetic factors were used to estimate the number of primary and secondary cases expected in this series of families, adequate agreement was obtained between cases expected and actually observed. In 59 families where both parents were negative, 57.92 primary and 43.61 secondary cases were expected when 60 and 41 cases, respectively, were observed. Similar agreement was found in the group of families where one parent was rheumatic. It is apparent that the risk for susceptible children to develop rheumatic fever is no greater before or after the onset of a case.

The primary and secondary cases expected were estimated as follows:

At the time of onset of the primary case, there is a specific sampling problem, since regardless of which siblings are genetically susceptible in the families, no cases have occurred up to the time of analysis. The total genetic expectancy for the family was apportioned unequally according to the age chance for each sibling to be the first case, using the age incidence factor. The actual number of primary cases expected was obtained by the application of the age attack rate factor.

The prediction of secondary cases was obtained by the direct use of simple genetic ratios corrected for current age risk using the cumulated age incidence factor.

In these analyses by the simultaneous application of age and genetic factors, the intrafamilial pattern of spread of rheumatic fever in 109 families was described in numerical terms. It is of epidemiological significance that during a period of twenty years, the annual incidence of cases and the occurrence of primary and secondary cases were satisfactorily estimated in these families on an age and genetic basis. It is apparent that whatever the nature of the agents responsible for the onset of the disease in genetic susceptible children at a susceptible age, they were uniformly operative at all times during the life experience of these families.

Interpretation of the fundamental basis for these findings must be speculative. It is reasonable to consider that the genetic risk is primary. It is possible that the age risk is inherent in the genetic risk. However, it is more likely that the age risk is secondary, reflecting the interval of time necessary for the expression or development of manifest disease.

The integration of genetic and epidemiological methods of analysis is an approach hitherto not formulated for rheumatic fever. The methods described may be utilized to evaluate etiologic concepts as well as prophylactic measures. Their usefulness in these studies suggests that their extension to other comparable problems of investigation may be profitable.

MAY G. WILSON
ROSE LUBSCHEZ
MORTON D. SCHWEITZER

6 R. L. Gauld and F. E. M. Read, *Jour. Clin. Invest.*, 19: 393, 1940.

7 A. Rosenblum and R. L. Rosenblum, *Am. Heart Jour.*, 23: 71, 1942.

THE EFFECT OF URINARY CORTIN-LIKE MATERIAL ON CARBOHYDRATE METABOLISM[1]

Previously we demonstrated that urinary extracts are capable of increasing the resistance of adrenalectomized rats to low environmental temperatures[2] as well as maintaining the lives of adrenalectomized rats.[3] Using glycogen deposition in the liver of the fasting adrenalectomized rat, we have now found that these extracts are able to influence carbohydrate metabolism in a fashion similar to that demonstrated for cortin and certain cortical compounds.[4,5]

The experimental procedure employed was a modification of the technique described by Reinecke and Kendall.[6] Adrenalectomized rats (140–160 gms) were fasted for 24 hours from the third to fourth day after operation. At the end of this period, the urinary extract was administered by stomach tube. Samples of the livers were removed and analyzed for glycogen by the method of Good, Kramer and Somogyi.[7] The urinary extracts used in this study are similar to those already described.[2,3]

In experiment A, the equivalent of 2 liters of urine dissolved in 1 cc of a 10 per cent. ethanol solution was administered once at 0 hours and again at 3.5 hours. The time of the termination of the 24-hour fast was reckoned as zero time. Samples of liver were removed between the seventh and eighth hours. In experiment B, the equivalent of 1.5 liters of urine dissolved in 1 cc of a 10 per cent. ethanol solution was administered at 0, 2.25, 4.5 and 6.75 hours. Samples of liver were removed between the eighth and ninth hours. All controls received 1 cc of a 10 per cent. ethanol solution at the hours indicated.

The results are presented in Table 1, in which the

TABLE 1

The Influence of Urinary Extracts on the Deposition of Liver Glycogen in Fasting Adrenalectomized Rats

Experiment	Total urinary equivalent administered per rat in equal doses (liters)	Total volume of solvent (10 per cent. ethanol) administered (cc)	Times of administrations after completion of 24 hr. fast (hrs.)	Number of rats	Mean glycogen in liver (range) (mg. per cent.)
A	0	2.0	0 ;3.5	5	15.5 (13.9–19.0)
	4.0	2.0	0 ;3.5	5	75.4 (21.1–128)
B	0	4.0	0 ;2.25 ; 4.5 ;6.75	3	16.4 (12.5–19.3)
	6.0	4.0	0 ;2.25 ; 4.5 ;6.75	7	178 (60.9–308)

liver glycogen values are expressed in mgs of glycogen per 100 gms of liver (mg per cent.). The mean liver glycogen concentrations of those animals receiving urinary extracts were increased 5 and 10 times, respectively, for experiment A and B as compared with the controls. It is evident, therefore, that these urinary extracts influence carbohydrate metabolism in much the same way as do adrenal cortical extracts.

Benjamin N. Horwitt
Ralph I. Dorfman

SCIENTIFIC APPARATUS AND LABORATORY METHODS

NON-VIRULENT FROZEN AND DRIED ANTIGENS FOR COMPLEMENT-FIXATION TESTS WITH CENTRAL NERVOUS SYSTEM VIRUS INFECTIONS

Two steps have already been taken in developing a specific, practical complement-fixation test for diagnosing central nervous system virus infections. The first was the production of antigens from infected brain tissue which, under stated conditions, gave specific and duplicable results;[1] the second was the rendering of the antigens non-virulent in order to make them safe for general use in hospital diagnostic laboratories.[2] We wish now to describe a third step, namely, the successful freezing and drying of small quantities of non-virulent antigens, thus permitting their distribution by central production laboratories and their use over relatively long periods of time.

Standard virulent antigens were prepared[1] by obtaining infected mouse brains, making them into a 10 per cent. suspension with diluent in a mechanical homogenizer, centrifugalizing the material at 2,500 r.p.m. in a horizontal centrifuge, freezing and thawing

[1] From the Brush Foundation and Department of Biochemistry, Western Reserve University School of Medicine, and Department of Medicine, Lakeside Hospital, Cleveland, Ohio. Supported in part by a grant from the Josiah Macy, Jr. Foundation.

[2] R. I. Dorfman, B. N. Horwitt and W. R. Fish, Science, 96: 496, 1942.

[3] R. I. Dorfman and B. N. Horwitt. In press.

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[5] C. N. H. Long, B. Katzin and E. G. Fry, *Endocrinology*, 26: 309, 1940.

[6] R. M. Reinecke and E. C. Kendall, *Endocrinology*, 31: 573, 1942.

[7] C. A. Good, H. Kramer and M. Somogyi, *Jour. Biol. Chem.*, 100: 485, 1933.

[1] J. Casals and R. Palacios, Science, 93: 162–3, 1941; *Jour. Exp. Med.*, 74: 409–26, 1941.

[2] J. Casals, *Proc. Soc. Exp. Biol. and Med.*, 49: 501–4, 1942.

it, and finally centrifuging it at 5,000 r.p.m. in an angle-head centrifuge and discarding the sediment. These preparations were then rendered non-virulent by exposure to the rays of a mercury arc lamp for a determined period of time.[2]

Freezing and drying of these antigens are accomplished in the following manner. The irradiated antigen is freed of sediment by centrifugation in a horizontal centrifuge for 10 minutes at 2,500 r.p.m. To the clear supernatant, merthiolate in a dilution of 1:10,000 is added. The antigen is then pipetted in 2 or 5 cc quantities into glass ampoules, frozen quickly by immersion into a dry ice-alcohol mixture, and dried over a period of 20 hours in a Flosdorf-Mudd apparatus,[3] after which the ampoules are sealed. The ampoules containing the desiccated antigen in an air-free space are stored at 2° C. When needed for use in tests the ampoules are opened and 2 or 5 cc of distilled water added to the desiccated material. A similar method was employed by Smadel and Wall for preserving spleen lymphocytic choriomeningitis antigen.[4]

In the following table the results of one test with an ampoule of irradiated frozen and dried Western equine encephalomyelitis antigen are shown. The figures in the first column indicate that the titer of the complement was the same with frozen and dried as with standard virulent antigen or saline control (0.13 cc), showing that the dried material was not anti-complementary. Column 2 indicates that the titer of dried and virulent antigens was the same, 1:8, showing that there was no loss of antigenicity from irradiation or freezing and drying. Finally, column 3 indicates that the fixation titer was the same in hyperimmune serum, whether virulent or frozen and dried antigen was employed.

Similar antigens with St. Louis and West Nile viruses have been prepared and tested. They have proved practically identical to the virulent antigens in antigenicity and specificity. Our observation of their keeping qualities is limited thus far to 6 weeks, but we believe that in view of universal experience with lyophilized materials, these antigens will maintain their specific properties for long periods of time.

TABLE 1

EFFECT OF IRRADIATION AND FREEZING AND DRYING ON THE COMPLEMENT-FIXING ANTIGEN OF WESTERN EQUINE ENCEPHALOMYELITIS VIRUS

(Antigen irradiated for 100 minutes; tested for virulence by intracerebral inoculation into Swiss mice. Out of 12 mice inoculated none died).

Antigen	Anti-complementary power*	Antigenicity†							Specificity and titer of serum‡								
		1:1	1:2	1:4	1:8	1:16	1:32	1:64	1:1	1:2	1:4	1:8	1:16	1:32	1:64	1:128
No antigen; saline control	0.13 cc								0	0	0					
Western equine encephalomyelitis, non-irradiated .	0.13 cc	4¶	4	4	4	0	0	0	4	4	4	4	4	4	1	0
Western equine encephalomyelitis, irradiated and lyophilized	0.13 cc	4	4	4	4	0	0	0	4	4	4	4	4	4	2	0
West Nile, irradiated and lyophilized	0.13 cc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* Amount of guinea pig serum in dilution of 1:30 equivalent to one unit.
† Dilution of antigen reacting with a constant amount of Western equine encephalomyelitis mouse immune serum.
‡ Dilution of Western equine encephalomyelitis mouse immune serum reacting with a constant amount of antigen.
¶ 4 = Complete fixation; 0 = complete hemolysis; 1, 2 = intermediate degree of hemolysis.

J. CASALS

THE LABORATORIES OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK, N. Y.

[3] Earl W. Flosdorf and Stuart Mudd, *Jour. Immunol.*, 29: 389–425, 1935.

[4] J. E. Smadel and M. J. Wall, *Jour. Bact.*, 41: 421–30, 1941.

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ZOETHOUT, W. D. *Laboratory Experiments in Physiology.* Illustrated. Pp. 256. C. V. Mosby Company.

SCIENCE NEWS

Science Service, Washington, D. C.

THOMAS JEFFERSON

Conjure up in your mind's eye five images of Thomas Jefferson, whose birth on April 13, 1743, two hundred years ago, is being celebrated this year. Stand them side by side. In the center is Jefferson the lawyer, statesman and public servant. To the right is Jefferson the music-lover, violinist and singer, and Jefferson, the horseman and lover of outdoor sports. To the left stands the scientist and inventor, and also the landowner and farmer.

These five Jeffersons together constitute the man whom history records as one of the most versatile persons in America's early days. His music and his horsemanship were his recreation. His inventions were his hobby. His "tranquil pursuit of science" was, to use his own words, his "supreme delight." He inherited nearly 2,000 acres of land and added another 3,000 by purchase. His father-in-law left him a 5,000-acre plantation to manage as an additional farming activity.

As a scientist Jefferson was interested in many branches: geography, geology, botany, zoology, medicine, agriculture, chemistry and the natural sciences. The practical side of all these appealed to him. He once wrote, "I have wished to see chemistry applied to domestic objects, to malting, brewing, making cider, bread, butter, cheese, soap, and the incubation of eggs."

Although the subject had not yet been named, Jefferson was a great early paleontologist. The fossil remains and the bones of prehistoric animals delighted him. He secured a number of the bones of an animal about the size of a bull moose found in a cave in Virginia. Because they included a large claw he called the animal the "big-claw" or Megalonyx. The bones were sent to Philadelphia and the animal "reconstructed." They are still there with the Academy of Natural Sciences. The animal was a giant ground sloth, extinct for some 30,000 years.

Jefferson collected many prehistoric bones through friends in Ohio, Kentucky and elsewhere. His great interest in paleontology was awakened by his contacts in Paris with leading scientists; in the days when Jefferson represented the United States Government there, Paris was the center of the sciences, particularly botany and zoology.

Thomas Jefferson, while president and at other times, seems to have had a keen sense of the important part science would play in the future of the American nation. His foresight is responsible for much of the scientific work done by the Government then and later. He is credited with being the originator of the patent system. The idea of a National Bureau of Standards is in a report by him to Congress in 1790. The report suggests plans for establishing uniformity in the coinage and weights and measures of the United States.

In 1806 President Jefferson recommended a coast survey, on which the Congress took favorable action in February 1807. The continuation of this survey work is carried on by the Coast and Geodetic Survey. Other recommendations had much to do with the establishment later of the Naval Observatory, the Hydrographic Office and the Weather Bureau.

Further evidence of Jefferson's great interest in the sciences is shown by two exploratory trips which he made possible. He sent Colonel Zebulon Pike to explore the peak that now bears Pike's name. He asked the Congress to authorize the expedition of Lewis and Clark. He paid from personal funds $2,500 to help finance the trip. The report of these two men, made from their notes written daily while traveling up the Missouri River and crossing to the Pacific, is filled with scientific observations resulting from instructions received by them from the President.

Jefferson as an inventor never took out a patent. In a large measure he is responsible for the creation of the U. S. Patent law and he was the first administrator of the law. Under it patents were issued by a board composed of the Secretary of State, the Secretary of War and the Attorney General. He was Secretary of State and chairman of the board. The work in connection with patenting was carried out in the State Department and the books and records kept there. Jefferson and his contemporary inventor, Benjamin Franklin, both decided to contribute their inventive genius to their country and to their fellowmen as they contributed their abilities in affairs of state.

Scientific principles were the basis of many of Jefferson's inventions. The moulding board of a common plow may not seem to be scientific, but it is. Jefferson sought a proper shape to turn the soil with the least effort, to break the soil properly, aerate it, and to cover the turned-in vegetation to add humus to the land. It was certainly regarded as a scientific achievement by several French scientific societies which awarded him honors for his invention.

His pedometer sounds more scientific. With it a distance could be measured roughly by walking it. A recording instrument was carried in the watch pocket. A tape led from the instrument through a hole in the bottom of the pocket, down "between the breeches and drawers" to a knee band. This recorded every step taken, by one leg at least.

Jefferson's "whirligig" chair may not be a scientific device, but it was an important invention. It is the great-great-grandfather of all the swivel chairs for which Washington is famous and without which perhaps modern governments could not exist. A combination walking-stick and outdoor seat did not prove as prolific. His hemp machine for breaking and beating hemp into fiber is one of his greatest inventions.

Architecture is a science. Jefferson's great work as an architect was the designing of the original buildings of the University of Virginia, still standing and in use. It is his greatest memorial. Monticello, his home, is also his work. American people are familiar with its outline, as it is now on one face of the new Jefferson five-cent piece.

SEARCH FOR AN ANTIMALARIA CHEMICAL

A great push to find a chemical remedy for malaria "which will not have the deficiencies of quinine, plasmochin and atabrine" is going forward, was reported by Colonel Paul F. Russell, of the Medical Department of


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the U. S. Army in the Herman M. Biggs Memorial Lecture at the New York Academy of Medicine.

"The need is apparent," he said, "when it is recalled that not one of this trio will cure with certainty, not one is a true prophylactic drug, and not one is of much value in the control of community malaria. It seems reasonable to hope that a more effective antimalarial will be developed in the not too distant future."

He pointed out that notable progress in controlling malaria even in tropical villages has been achieved with pyrethrum spraying. Experiments in rural South India in 1942 proved that the chain of malaria infection can be broken by this method in typical small villages at a per capita cost of about five cents a year, which is economically feasible even in India. The method consists in weekly spraying of huts, cowsheds and outbuildings where the malaria-carrying mosquitoes tend to remain.

Colonel Russell stated later that malaria kills at least 3,000,000 persons throughout the world each year and there are at least 300,000,000 cases of malarial fever. In such areas as Burma, New Guinea and the Solomons, malaria is by all odds the greatest disease hazard to our troops and is in some places a greater menace than the enemy. He continued, "it seems incredible that malaria still can be so great a scourge, for it is a preventable disease regarding which we possess as complete knowledge as for any human malady. There have been devised potent weapons for treatment and control. But malaria persists, of all diseases to-day probably the most effective barrier to prosperity, contentment and health. What a paradox! Man, with his incredible machines and his streamlined science, stricken each year in millions because he fails to outwit a mosquito carrying Death in its spittle!"

RADIO-QUALITY QUARTZ CRYSTALS

NUMBER ONE strategical mineral problem at present is a domestic source of supply of quartz crystals suitable for radio equipment and other electrical uses in the war effort. Radio is the life line of the armed forces. Battle movements of soldiers, sailors and airforces depend upon it. Dependable instruments in which crystals are used must have crystals of the finest quality.

Brazil and other South American countries are the sources of the present supply. In the United States there are plenty of quartz crystal deposits, but satisfactory crystals for electrical uses had not been developed from them in pre-war days. An intensive search is now being made by the U. S. Geological Survey, the Bureau of Mines and other agencies, to locate quartz crystals with the necessary properties. Results of the search are promising, although specific information will not be released until after the war. The best prospects appear to be in the crystals found in North Carolina, Virginia, Arkansas and California. The western mountain states are being searched as well.

Not all quartz crystals, regardless of their general resemblance, are usable in electrical work. They must be first cut, and then carefully tested in well-equipped laboratories for their electrical properties. Size and appearance are, however, important factors. To be usable they should be at least an inch in diameter and over two inches long. They should be clear, and free from fractures and discolorizations.

Quartz crystals are used in microphones, and as electric filters and oscillators. The so-called piezo-electric quartz crystal vibrates as an electric charge on its surface oscillates. The constancy of the rate of vibration is remarkable. It is more constant than the pendulum on a high-grade astronomical clock. A crystal of good quality kept at a constant temperature will not vary two seconds in ten days. It is this reliability that makes it essential as an electric oscillator.

ITEMS

FOOD crops for production in 1943 are more important at the present moment than guayule plantings for rubber in 1945. Since the recommendations of the Baruch committee were issued urging a greatly increased guayule raising program, the situation has changed. "The need for the maximum food production has become more pressing, and the outlook for synthetic rubber has become somewhat clearer," is emphasized by Secretary of Agriculture Wickard and Rubber Director Jeffers. Both feel that it is not desirable to use any large quantity of land for planting the rubber plant this year as the first rubber yield would not be until two years from now. Not only is the land needed for food crops but the manpower is needed also. The Department of Agriculture is planning to have plenty of guayule planting stock available in the nurseries in case a further survey shows by mid-summer that emphasis should shift again to rubber production.

"THERMOPLASTICS, like their thermosetting cousins, perform many necessary functions in electrical equipment, and the technical apparatus of the electronic world of the future will be served both by the material with which we are familiar, and by newer and better ones," according to H. K. Nason of the Monsanto Chemical Company who spoke at the Pittsfield, Mass., meeting of the American Institute of Electrical Engineers. These plastics are now serving many useful purposes in electronics, he continued, but much work is being done in industrial and other laboratories to develop a thermoplastic that will meet the full needs in the electronics field. This requires material which can be used in situations where high temperatures are encountered, and plastics that will not "creep," better known as cold-flow. The progress being made will not be reported upon until after the war.

VICTORY gardeners who have heavy clay soil to contend with may be able to improve its texture by the addition of sifted anthracite coal ashes and at the same time dispose of the ashes. Coal ash, it is pointed out, improves only the physical state of the soil; it is not a fertilizer. And only anthracite ashes are safe to use. Clay soils are sticky when wet, and hard when dry. Coal ashes will decrease the stickiness and help prevent the hardness. The amount to use depends upon the soil, but ordinarily two inches of ashes plowed or spaded into six inches of the topsoil is sufficient. The ashes and soil should be well mixed. Vegetables, flowers and grasses will grow better in soil so treated and the labor of taking care of the garden is lessened. Sandy soils are also improved by anthracite ashes. Their moisture retention properties are increased. In this the ashes have an effect similar to that of human.

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SCIENTIFIC PUBLICATIONS OF THE GOVERNMENT[1]

PUBLICATIONS OF THE U. S. PUBLIC HEALTH SERVICE

By Dr. ATHERTON SEIDELL

U. S. PUBLIC HEALTH SERVICE

A GREAT majority of the members of the Washington Academy and its affiliated societies are engaged in research in governmental laboratories. They are the authors of the papers in which by far the larger part of governmental research is described. Although the preparation of these papers is in itself a certain satisfaction, since they are the evidence of worthwhile accomplishments, the real purpose of their publication is to aid others engaged in the advancement of science. This, however, is possible only if the papers find their way to persons engaged in research of a similar kind. This link in the chain of scientific progress is usually given very little attention. Most of us consider that our duty is done when our papers are accepted for publication. We assume that it is the concern of others to obtain them and not ours to render this task less difficult.

The channels through which papers describing additions to scientific knowledge are most widely distributed are the well-known, regularly appearing, and internationally circulating journals, especially those devoted to specific fields of research. In general, our governmental publications meet these specifications to an exceedingly limited degree. They are usually published irregularly, are of a heterogeneous character, and but a very small proportion of any of them ever get beyond the borders of our country. Descriptions of experimental investigations published in them can thus rarely reach workers in other countries who would be able to use them to advantage.

[1] Papers presented at the January 21, 1943, meeting of the Washington Academy of Sciences.

Fortunately, a large proportion of the scientific papers originating in governmental laboratories are published, with official permission, in journals which insure their distribution to those for whom they were intended. It is only the variable proportion which are reserved for publication in the bulletins, periodicals and serials of the governmental bureaus which largely fail to reach research workers beyond our borders.

An examination of the records of papers originating in the National Institute of Health shows that, of an average of some 434 prepared each year since 1938, only about 125, or less than 30 per cent., were printed in Service publications. Of these, a considerable proportion were of an informational character, hence the number which may be classed as contributions to new knowledge, and thus of particular interest to research workers throughout the world, was relatively small. Their number, however, together with those originating in other governmental institutions is certainly sufficient to justify an examination of the conditions under which they are published and the interests and needs of those to whom they are distributed.

The principal publication of the Public Health Service is the weekly *Public Health Reports.* This contains, (1) statistical information in regard to the prevalence and distribution of communicable diseases, (2) articles relating to the cause, prevention and control of disease, and (3) other pertinent information regarding sanitation and the conservation of public health. It is under the second of these headings that many papers describing the results of highly technical laboratory research are published. The details in these papers are of interest, for the most part, only to workers in similar fields. They are largely wasted upon the great majority of those who receive the publication and who undoubtedly find it helpful for the statistical disease records and informational papers concerning public health administration and amelioration, which it contains.

The mailing list of the *Public Health Reports* is made up principally of persons engaged in public health work. Of a total weekly edition of somewhat more than 7,000 copies, 3,382 go to officers and employees of national, state, and city health departments, 423 go to nurses, and 786 to individuals and institutions. Public libraries receive 860 copies, and medical libraries and universities together receive 561. At present, about 400 copies go to countries other than continental United States and its territories. The distribution in these cases is also largely to health officers and health departments. None, of course, at present, reach the enemy or occupied countries, and a reserve of only 100 copies of each issue is being held to supply the needs of these nations after the war.

The total number of *Public Health Reports* being sent to enemy and occupied countries at the time of our entry into the war was about 200 copies. These were distributed approximately as follows: Germany 32 copies, France 24, Scandinavia 16, Italy 13, Netherlands 10, Russia 6, Belgium 5, Switzerland 4, and all other European countries 36. To China and the Middle East about 40 copies were being sent.

It is estimated that an average of more than 30 strictly scientific papers, making up some 300 pages, or about 15 per cent. of the total contents of the *Public Health Reports* each year, go to a very large number of persons who can have little interest in them, and fail to reach by far the larger proportion of those who would be able to use them for the advancement of science.

In addition to the *Public Health Reports* a series of monographs of a strictly research character are published as *Bulletins* of the National Institute of Health. These are printed in editions of about 2,500 and go largely to libraries, universities and research institutions. The variety of subjects dealt with in these *Bulletins,* their appearance at irregular intervals, and the restricted method of distributing governmental publications beyond our borders, makes it almost impossible for any considerable part of them to reach workers and institutions in other countries. They thus play a very insignificant role as international contributions to the advancement of science.

A publication of our Service, which is very little known, is entitled *Hospital News.* It is published by the planographic method twice a month in an edition of about 1,300 copies and contains brief articles on clinical research, case histories, practices, observations, and reports on improvements in methods and devices. It is a medical periodical of considerable merit, but its circulation, due to administrative limitations, is restricted exclusively to the personnel of the Public Health Service engaged in hospital and relief activities. It is, however, certainly well worthy of a far wider distribution among the medical profession of this and other countries.

Finally, a recent addition to the Public Health Service publications of a purely research character is the *Journal* of the Cancer Institute. This represents the nearest approach so far attained under governmental auspices to the requirements of efficient distribution of scientific papers originating in governmental laboratories. This journal follows the trend of specialization in scientific periodicals in being devoted to a single field of research. It is issued regularly six times per year at a fixed subscription price. Although this journal, like all other government publications, is distributed free to accredited libraries, institutions, and many individuals in the United States,

the Superintendent of Documents has received more than 150 paid subscriptions to it. This case might well be taken as an example of the trend towards which the evolution of governmental publication of scientific research should proceed. It may be expected that specialized periodicals of this type may eventually provide a self-supporting means of publishing all research originating in governmental laboratories.

THE PUBLICATIONS OF THE NATIONAL BUREAU OF STANDARDS

By J. L. MATHUSA and K. S. GIBSON

A. Number and Character of Publications, Including Journals, Serials and Miscellaneous

Nine series of publications are issued by the National Bureau of Standards, including the *Journal of Research of the National Bureau of Standards,* Research Papers, Circulars, Handbooks, *Technical News Bulletin,* Commercial Standards, Simplified Practice Recommendations, Building Materials and Structures Reports and Miscellaneous Publications.

1. *Journal of Research, NBS*

The *Journal* is issued monthly and makes available the results of fundamental research (other than confidential work for the Army, Navy and war agencies) in progress in the Bureau's laboratories, including new developments in science and technology.

2. *Research Papers*

These are separate reprints of the articles appearing in the *Journal of Research.* Since the *Journal* covers a variety of subjects, technical groups, research workers and others find it advantageous to obtain the separate papers relating to the subjects in which they are interested. The research papers serve an administrative need in discussing programs of research and in furnishing technical information.

3. *Technical News Bulletin*

This is issued monthly. It contains short articles reporting progress of work, abstracts of articles that appear in the *Journal of Research,* accounts of scientific and technical meetings in which the Bureau staff has participated, and lists of articles by members of the Bureau staff, whether printed in the Bureau's own series or in scientific and technical journals.

4. *Circulars*

The Circulars are compilations of information on various subjects associated with the Bureau's scientific, technical and engineering activities. They include not merely the results of work done at the Bureau, but give information from many other sources. Examples are the National Petroleum Oil Tables; Polarimetry, Saccharimetry, and the Sugars; Static Electricity; Testing Volumetric Glassware; A Test of Lens Resolution for the Photographer. Over 400 of these Circulars have been issued.

5. *Commercial Standards; and 6, Simplified Practice Recommendations*

These are pamphlets issued and revised from time to time as a record of agreements reached with industrial organizations on the qualities, types, and styles of manufactured products. The distinction between the two series is that the Commercial Standards are primarily recommended specifications of quality or performance, whereas the Simplified Practice Recommendations represent voluntary agreements to reduce the number of types and varieties to be given preference in trade practice. Both are developed cooperatively with the industries concerned, through standing committees working with the Bureau on the various projects. During the present emergency the War Production Board and the Office of Price Administration are incorporating the provisions of many of these recommended standards in their mandatory limitation and control requirements, thus conserving strategic materials and manpower.

7. *Handbooks*

These are recommended codes of engineering practice, such as the National Electrical Safety Code, Code for Protection Against Lightning, Protection of Radium During Air Raids, Safety Rules for Electric Fences, Safe Handling of Radioactive Luminous Compounds. They are developed jointly with the industries, engineering standardization groups and national organizations concerned. Over 30 such codes have been issued. In many cases these recommended requirements are given legal status through incorporation in local ordinances by State and municipal regulatory bodies.

8. *Building Materials and Structures Reports*

This series was begun in 1938. It reports the results of work on funds specially appropriated by Congress for the investigation of materials and methods of construction for low-cost housing, including the Government's program of defense housing. The investigations have furnished the Government, the building industry and others concerned information from practically every available source on the engineering properties of materials as incorporated in structural elements and equipment. Recent reports

deal with water-distribution systems for buildings; asphalt-prepared roll roofings and shingles; floor coverings; plumbing; moisture condensation in building walls; water permeability of walls built of masonry units; and a large number of reports on the structural properties of walls, partitions, and floors. Over 90 such reports have been printed.

9. *Miscellaneous Publications*

These are items which do not fit into any other Bureau publication series. In many cases they are charts or other material which has to be of a different size for appropriate printing. Examples are the metric chart, the encyclopedias of specifications, reports of the National Conferences on Weights and Measures and pamphlets more distinctly of an administrative nature.

B. Diversity of Scientific Fields Covered in Each

Publications of a scientific, technical and engineering nature emanate from all the scientific and engineering divisions of the Bureau; these cover the fields of electricity, weights and measures, heat and thermometry, optics, chemistry, mechanics and sound, organic and fibrous materials, metallurgy, and clay and silicates. A few of the specialties within these fields relate to electrochemistry, radio and magnetic measurements; length, time and mass; heat measurements, automotive power plants and thermometry; polarimetry, photometry and radioactivity; pH standards, gas and paints; aeronautic instruments and hydraulics; rubber, textiles and plastics; metallurgy of various kinds; and cements and glasses. Over seventy such sections are represented in the organization of the scientific and technical divisions. The Commercial Standardization Group includes the activities on the development and use of specifications, the Commercial Standards and Simplified Practice projects, and the building and engineering code services.

C. Size of Editions and Limitations on Distribution

In most cases, the official editions of the Bureau's publications are limited to 1,000 copies. In addition, the Superintendent of Documents prints such copies for sales purposes as the extent of interest in the subject may seem to warrant. The Bureau's distribution of official copies is restricted to the libraries of leading scientific, engineering, and technical organizations, and to educational institutions, where it is expected that they will be available for general reference use. In many cases, the publications are forwarded in exchange for the technical periodicals issued by these organizations. The Superintendent of Documents also distributes free copies of Bureau publications to the several hundred Government depository libraries throughout the United States. Recent figures show over 1,400 subscriptions to the monthly *Journal of Research* and *Technical News Bulletin*. Over 40,000 copies of the Handbook on Screw Thread Standards have been sold, and the purchase of the recently issued parts of the National Electrical Safety Code has exceeded 33,000 copies. Sixteen thousand copies of the Simplified Practice Recommendation on Machine Carriage and Lag Bolts have been sold. The current Circulars on Synthetic Rubber and Properties of Dental Materials have had several reprintings.

D. Interests and Activities of the Institutions and Individuals on the Mailing Lists

As indicated above, the distribution of the Bureau's publications is to public libraries, standardization and technical research groups, leading national research societies and the libraries of other organizations doing research work in physics, chemistry and engineering, or concerned with problems of research and standardization on which the Bureau is engaged. No individual mailing lists are maintained. In many cases cooperative programs of research are in progress, and the Bureau's staff in many instances are members of the society or association engaged in the development of specifications and standards of practice and in the securing of basic research information. Examples are the American Standards Association, American Society for Testing Materials, American Society of Mechanical Engineers, Society of Automotive Engineers, etc. In many cases the research associates representing these organizations are working in the Bureau's laboratories, and their results are printed by the Bureau.

E. Proportion Sent Outside the United States

Because of censorship limitations and procedure, the official distribution of Bureau publications to countries other than Canada has been suspended. The mailing to many European countries was abandoned in 1940. Before the war, the distribution of the *Journal of Research* to foreign countries exceeded 600 copies, many in exchange for foreign scientific and technical periodicals.

F. Extent to which Institutions or Persons in Other Countries Can Obtain or Gain Access to Bureau Publications

Except for the present limitations indicated in E, the publications of the Bureau have been available in many of the leading foreign libraries. The sale of Bureau publications by the Superintendent of Documents makes them generally available.

THE PUBLICATION OF SCIENTIFIC AND TECHNICAL MATERIAL BY THE UNITED STATES DEPARTMENT OF AGRICULTURE

By Dr. M. C. MERRILL
CHIEF OF PUBLICATIONS, U. S. DEPARTMENT OF AGRICULTURE

THE Department of Agriculture was created by act of Congress May 15, 1862. The act stated that the "general designs and duties" of the Department "shall be to acquire and to diffuse among the people of the United States useful information on subjects connected with agriculture in the most general and comprehensive sense of that word." During the 79 years of its life up to the present war the department issued 253 series of publications, including 43 periodicals, all of which are now defunct. The total number of separate publications (not copies) in the numbered series was 10,516. These were issued from 66 bureaus or units, some of which have, of course, passed into the realm of the deceased along with their publications. Most of those series had bureau or division designations and were typical of the bureaus' publication independence to a large degree in the early years. It was not until 1913 that the bureau series were largely consolidated into the department series.

At the outbreak of the second world war the department was issuing 98 series of publications, including 16 periodicals. These were exclusive of the publications prepared in the Bureau of Biological Survey, the Food and Drug Administration, the Bureau of Public Roads, and the Weather Bureau that had been transferred to other agencies.

Thus the passage of time has brought numerous changes in the administrative phases of the department's publication program. Though the form and structure of its technical publications have remained well stabilized through the years, their content has undergone extensive modification. First published in the era when a professor of agriculture was taking his place on college faculties and was a recognized authority in the broad fields of cultivated plants, domesticated animals, and soils, the early agricultural bulletins bore evidence of that generalization. And yet it is surprising what splendid scientific work was done in those days under the conditions prevailing and how well and carefully the results were authenticated so that they became monuments of established validity and finality built to endure a long time. We accordingly appreciate that work and honor the workers who labored as best they could without either knowledge or benefit of the modern methods and materials, technic, equipment, and statistical interpretations so commonplace in present-day publications.

Along with this development in the content of the scientific publications of the department has come the age of specialization when each scientist in his research work is concentrating on ever-narrowing fields of inquiry. Hence when he publishes the results of studies in his specialty it is natural to expect that the number of professionally interested readers will also become smaller and smaller as the specialty narrows down. One authority in the field of the social sciences recently remarked that the subject matter there has become so specialized that at the scientific meetings held by the general organization he as a specialist in one field has a hard time understanding the specialists in other fields if he happens to stroll into their meeting and listen to some of their papers. The physical, chemical, and biological scientists are also earnestly engaged in building this scientific Tower of Babel.

The series in which the major part of the research and technical material now published by the department is issued are the *Journal of Agricultural Research,* Technical Bulletins, Circulars, Miscellaneous Publications, Statistical Bulletins, and Soil Surveys. For our purpose here let us confine our consideration to only the first three (*Journal of Agricultural Research,* Technical Bulletins, and Circulars). The *Journal of Agricultural Research* publishes only articles carrying original research done in the department and at the State Agricultural Experiment Stations. Usually only one phase of an investigation is covered and each paper therefore may be regarded somewhat as a progress report. Even though the *Journal* does not ordinarily publish papers in economics, sociology, physics, or engineering, but only on subjects related to the botanical, chemical, mycological, cytological, genetic, nutritional, entomological, pathological, physiological, ecological, morphological, anatomical, and taxonomic phases underlying the production of plants and animals from the soil, the variety is wide, as you will appreciate, and each volume contains a mass of scientifically heterogeneous material. Naturally no one scientist is particularly interested in all of it but only in the articles published in his special field. To take account of that circumstance and provide for it, each article in the *Journal* is issued and distributed as a separate. Thus the *Journal* proper has its major usefulness in libraries, departments, or laboratories where several will see it. It is not sent free to individuals.

The Technical Bulletins contain the more compre-

hensive results of investigation. Each publication is accordingly a separate, independent entity with a more or less complete statement of the study and findings in the subject covered. Though the bulletin is in a numbered series its subject may be entirely unrelated to that of the one preceding and of the one following. The Circulars issued by the department are semi-technical in character, some leaning toward the popular and others toward the technical aspects.

It, of course, is one thing to prepare and issue printed matter, but what about its distribution? How many copies are published and where do they go? For a partial answer to these questions let us look into the distribution records for these series.

For free distribution we order nearly 2,000 copies of the *Journal*. In addition to that number the Superintendent of Documents provides as many as are needed for the approximately 546 depository libraries entitled to receive free all material issued by the government. Before this war the *Journal* was going to institutions in 84 foreign countries in exchange for their publications. Many years ago a study both in this country and in Europe by Dr. Karl F. Kellerman, the father of the *Journal*, led him to the conclusion that neither scientific reviewing journals nor libraries paid as much attention to bulletins as to the material published in journals because in the latter it is more accessible by virtue of the volume indexes, a convenience not ordinarily provided in individual bulletins.

The free mailing list for the *Journal* shows that it is being sent to the following:

98	copies	to	university libraries
179	"	"	college libraries
91	"	"	laboratories
198	"	"	experiment stations
90	"	"	department field offices
43	"	"	other government departments
39	"	"	societies and institutions
59	"	"	state government departments
76	"	"	department bureaus and divisions
58	"	"	public libraries
57	"	"	miscellaneous
777	"	"	countries outside of continental United States

During the war of course the sending of our published material to foreign countries is greatly restricted, but as it comes off the press that which can not be sent now is wrapped and held for mailing after the war.

In addition to the distribution indicated above the originating bureau or experiment station is given 250 copies of the separate of each article it submits.

During the fiscal year 1941 the Superintendent of Documents sold 672 subscriptions to the *Journal* and 18,825 copies of separates; in 1942, he sold 518 subscriptions and 15,876 copies of separates. This decrease was undoubtedly caused by the war. But these figures nevertheless indicate a fairly wide distribution of *Journal* material.

The editions of Technical Bulletins and Circulars for free distribution by the department normally range from 2,500 to 3,500 copies. To these are added the necessary copies for the depository libraries and the sale stock. The mailing list distribution is made to practically the same institutions as given above for the *Journal*. In the last fiscal year we distributed free 593,865 copies of Technical Bulletins and Circulars, and the Superintendent of Documents sold 53,448 copies.

Because of the pressure upon our printing funds from so many angles for the various types of material issued by the department, ranging all the way from the highly scientific and technical to that which is very popular and even of ephemeral interest, it has not been possible, and it is probably not desirable, for the department to publish all of the technical and research papers written by its staff. During the last fiscal year there went through my office 1,974 articles, nearly all of technical nature, for delivery outside the department or publication in outside journals. To provide for the further distribution of 265 of these, about 200 copies of reprints of each were purchased. In comparison with these 1,974 articles delivered or published outside the department, there were sent to the Printing Office for publication by the department only 237 manuscripts, or 12 per cent. as many, for the *Journal*, Technical Bulletin, Circular, Miscellaneous Publication, Statistical Bulletin, and Soil Survey series.

Now whether the publication program of the department is fully fulfilling the measure of its creation and adequately meeting the requirements of the scientists in this country and throughout the world who can make best use of the information is a question to which a great deal of thought has been given. Editorially we have tried to present the information as clearly, concisely, and effectively as possible, and to maintain high standards of publication in the interest of the readers. We have also tried to distribute this information wisely and get it into the hands of those who can use it to best advantage. But no doubt there is room for improvement all along the line and it is accordingly hoped that out of the discussion to-night will come some valuable suggestions for our guidance.

DISCUSSION OF SOME ASPECTS IN THE PUBLICATION OF GOVERNMENT RESEARCH

By RALPH R. SHAW
LIBRARIAN, U. S. DEPARTMENT OF AGRICULTURE

Creation and dissemination of knowledge are twin processes. Dissemination is the mechanism through which the results of research are made effective over a greater sphere of human endeavor; it makes possible the application of new knowledge to human welfare and to the creation of more or sounder knowledge in the laboratory.

The question of form of publications both primary (in the sense of new contributions to knowledge) and secondary (in the sense of interpretations or organization of knowledge) has received the attention of scientists, publishers, editors and librarians for many years, and yet no complete answer to the many complex problems involved has been discovered.

Bibliography, as an art, was first practiced by scholars whose aim was to combine into one easily digested capsule all the world's knowledge relating to a subject in hand.

Dr. Atherton Seidell's recommendation of the publication of narrowly limited subject periodicals by the Federal Government is, therefore, in the classical tradition, and it looks toward the filling of one of the many lacunae in the dissemination of knowledge. In so far as it groups like knowledge together, it is an aid in the organization of knowledge and in the provision of ready access to more of the results of research.

If it is considered as a substitute for other publications, then this proposal has a number of implications for future research, and implementation of research through publication, that require serious consideration.

The grouping of all the governmental research output into a limited series of subject publications has been under some consideration by official sources as an economy measure. Obviously, the only way to cut printing expenditures, if unit printing costs are kept constant, is to publish less of the results of research, and that measure, although necessary to a certain extent in wartime, is not desirable, and will, I believe, result in waste rather than in economy in the long run.

Even the view that time in searching will be saved by consolidation of those products of governmental research which actually do now appear in government publications into subject journals is open to question, because only a fraction of the federal research output is now published at government expense, and it would still be necessary for specialists to consult the other journals in which federal research in their fields is printed.

If it were attempted to overcome that by printing all the results of federal research in such journals, then printing funds would have to be increased enormously, and even that would not achieve the utopia of one book only for each specialist, because there would still be the necessity for scanning the great mass of publications reporting the research of state agencies, associations, private groups and foreign governments.

All this consideration is, of course, based on the assumption that we have achieved specialization to an extent such that each scientist works exclusively in a narrowly delimited subject field. The interdependence of research in various fields is, in fact, so great that almost no one can afford to neglect developments in related fields.

As a case in point, look at any recent number of any indexing or abstracting journal. In a recent issue of the *Experiment Station Record,* for example, under "Animal Production" you will find: papers read before the American Institute on Nutrition, reports published in the various series issued by the state experiment stations, books, articles in journals issued by various federal agencies, general science journals such as Science, applied chemistry journals, such as *Industrial and Engineering Chemistry,* foreign governmental research journals, medical veterinary journals and many others, almost all of which treat this one subject from differing points of view.

Looking at this question from still another point of view, it must be noted that most of the government journals are now subject journals. The difference that now exists between such specialized publications as the *Journal of Agricultural Research* (which, as Dr. M. C. Merrill pointed out, is limited to certain segments of the limited field of agriculture) and the still more narrowly limited specialized journals that Dr. Seidell recommends, is merely a matter of degree. In fact, if cancer research develops at the rate that we all hope it will, the *Journal of the Cancer Institute* may itself be a general journal in its field ten or twenty years from now.

Still another factor that might well be considered is the effect of a drastic change in government publishing policy upon the fortunes of association, scientific, trade and technical journals which are an important link in the chain of dissemination and interpretation of scientific knowledge. As noted in Dr. Merrill's paper, these journals assume a very large share of the task of publishing the results of government research. Such

publications as these, if duplicated by federal journals on heredity or on phytopathology or on what you will, would lose not only their generally shaky financial stability, but would also lose one of their main sources of research publications. It seems doubtful that science, the government or society has much to gain from competition with these useful publications. Any plan for federal publication of subject journals, if it is to improve dissemination of knowledge, must be designed to supplement rather than to supplant these valuable self-supporting journals.

A considerable number of papers reporting results of research can not now find space in all the existing channels combined. These contributions are now published only by deposit in libraries, which then make them available in microfilm or photostat copies. This indicates that such subject journals as Dr. Seidell recommends might be added to the channels of publication, where they do not duplicate other existing channels, with very profitable results.

Regardless of the form of organization of publications as physical objects, the key to giving publications power is the organization of the information contained in the articles or books.

There is a wide variety of techniques for this purpose. In addition to general indexes, abstract journals, and the like, there are specialized tools such as the Index-Catalogue of the Surgeon General's Library, or the Plant Science Catalog of the Department Library, the Bibliography of American Economic Entomology, the Bibliography of Agriculture, the Experiment Station Record, the Index-Catalogue of Medical and Veterinary Zoology and our many special subject bibliographies, which attempt to organize knowledge for use.

Effective use of such tools requires that the literature they list be made available to all scientists throughout the world. To this end, the Department Library, with the aid of Mr. Watson Davis, of the American Documentation Institute, and Dr. Atherton Seidell, has developed its microfilm service, which now provides some twelve thousand articles a year to workers at a distance. In one recent month our Bibliofilm Service supplied film copies of more than sixty thousand pages.

The need for better guides to the content of the world's literature is clearly shown by the classic case of Mendel's work, which was lost to science despite the fact that it was actually published, because it was not published in one of the journals in general circulation, and it was not brought out in a generally distributed index.

Existing indexing and abstracting journals in our fields regularly cover only a small fraction of the 11,500 periodical and serial publications regularly received in the Department Library, and we do not receive all the periodicals in our field of work. Thus a very large percentage of knowledge that is created in laboratory and field all over the world is not readily available to those who should have it. Furthermore, there is a considerable amount of duplication among indexes. It seems to me that serious consideration should be given to the problem of organizing the *content of publications* so that all pertinent knowledge, no matter how written, where published or in what language it is printed, may be promptly and readily available to all men working in any scientific endeavor.

I hope that we may work together with scientists, publishing agencies and librarians of other countries to effect this end after the war is won.

OBITUARY

ALBERT LLOYD BARROWS

1883–1942

For more than twenty years the National Research Council has been largely the lengthened shadow of Albert Lloyd Barrows, who was its executive secretary. His death makes it possible to say this. He would have denied the statement vigorously. Over many years' association I have never heard him say that *he* had done a particular task. The task was done only when some one else took responsibility, applied a signature, called a meeting or set the terms of a policy. He would have thought that he had failed if his views were put forward by himself. He was engaged in an associative enterprise. It was his self-imposed task to find the institution or the man who would establish a new current or pool of interest or drive forward with new energy toward an agreed objective.

He had an unlimited faith in that great American institution which we call the huddle: the habit of agreeing, after debate, on a decision that all could sustain. How often we, his associates over many years, have said, "More than any one else, Barrows is the NRC"! Not the least part of him was his devotion to high scientific standards. He was elected to Phi Beta Kappa and Sigma Xi. He had a well-trained and well-informed mind inspired by the ideal of national service and duty.

Thousands will bear witness to-day to these conclusions. He never thought of himself, served himself or spared himself. To the representatives of more than seventy affiliated organizations and to successive

chairmen of the council and of its divisions, he was an indispensable strength. He knew what the scientific men of America could do.

An executive who shares responsibility for an organization is always looking ahead. There is little enough time in which to reflect leisurely upon or take satisfaction in accomplishment that meets with general approval. His day is lived mostly in to-morrow. One remembers the almost superhuman drive which Barrows put into the things that to-morrow had to put forth. This gave his work the relentless quality of time itself. Time, organization, men and officers, with Barrows added in, became one inexorable continuum. A force reached out from his desk to every part of the country and into every institution where creative work was done in science. He would repudiate my words if he could hear them. He thought of himself only as the agent of an idea—how organization and consultation could promote progress in scientific research. I remember how greatly Oscar Firkins's definition of an institution pleased him: "Whenever man finds a useful idea he creates an institution, systematically to remind himself of the idea."

He could scarcely be brought to talk about his family and he did so in a rare and shy way that was endearing. Only once did he seem to speak spontaneously on that theme—when mention was made of his son's part in the present war as a Lieutenant on a submarine in the Pacific. And what a part! To be told when the war becomes history. His enthusiasm reflected perhaps his own disappointment when our armed preparations began that it seemed best to remain at his post rather than resume active military work at fifty-nine, if indeed he were allowed to do so. For thirty years he had trained for it as a Lieutenant Colonel in the Infantry Reserve. (He had been Captain of a Machine Gun Battery in France, 1917–1919, and won the Croix de Guerre by dangerous reconnaissance at Audenarde in the final push in Flanders.) He loved the techniques of modern military tactics and the possibilities of their efficient use under the chain of unified military command.

He was a born organizer for defined purposes. The purpose was uppermost. He had an essential instinct for loftiness of purpose and was visibly inspired by it. He had an unquenchable public spirit. If paper work occasionally dragged him down, a turn on his motorcycle or a tour of duty in the reserve officers' corps or a new plan of action and new men and forces in the National Research Council would restore him quickly to his natural rate of putting organizational power back of an agreed plan or idea.

It was most fitting that the memorial services held on November 11, 1942, should have consisted largely of the reading of a few of his favorite poems. There was a passion in his work for the Council and in his spirit that only certain emotional forms of poetry could express. Many who knew only his professional drive and his formal manner missed an integrating and profoundly sustaining quality, his capacity for feeling and for the beautiful expression of it. Now that we can appraise the whole of his life we can choose our viaticum with a better sense of appropriateness in a few lines from Kipling's tribute to the devoted teachers of his school:

> For their work continueth,
> And their work continueth,
> Broad and deep continueth,
> Great beyond their knowing.

ISAIAH BOWMAN

RECENT DEATHS

DR. WILLIAM ALBERT SETCHELL, professor of botany, emeritus, of the University of California at Berkeley, died on April 5, 1943, in his seventy-ninth year.

DR. MARY JANE RATHBUN, honorary associate in zoology of the U. S. National Museum, died on April 4 at the age of eighty-two years.

DR. GARFIELD POWELL, assistant professor of chemistry at Columbia University and an assistant to the dean of Columbia College, has died. He was forty-nine years old.

THE death on March 30 is announced of William Oscar Walker, for the last twenty-five years professor of chemistry at McMaster University, Canada.

SCIENTIFIC EVENTS

TUFTS COLLEGE CHAPTER OF THE SOCIETY OF THE SIGMA XI

THE Tufts College Chapter of the Society of the Sigma Xi was formally installed by the national officers of the society on April 2. The day's activities began with an academic procession and convocation, attended by the Tufts College faculty and student body as well as by the national officers and delegates from chapters in many other institutions. At the convocation exercises Dr. Leonard Carmichael, president of the college and member of Sigma Xi, gave a brief history of scientific research at the college. Dr. George Baitsell, of Yale University, national secretary; Dr. Harlow Shapley, of Harvard University, national president, and Dr. Edward Ellery, of Union College, past national president, were introduced and presented interesting accounts of the growth and aims of the Society of the Sigma Xi. A luncheon for the

national officers, the visiting delegates and the college members of Sigma Xi followed.

Dr. Shapley and Dr. Baitsell officiated at the formal installation ceremonies, which took place at 3 P.M. in one of the small college chapels. The new charter was accepted in behalf of the Tufts Chapter by President Carmichael, while Dr. Ellery responded for the society. The newly installed chapter elected the following officers:

President, Dr. Basil G. Bibby, dean of the Tufts College Dental School; *Vice-president,* Dr. Katharine F. Billings, instructor in geology; *President-elect,* Dr. Paul Warren, professor of botany; *Treasurer,* Dr. Herman Sweet, assistant professor of biology; *Secretary,* Dr. Nils Y. Wessell, dean of men.

A tea and reception followed at the home of President and Mrs. Carmichael. In the evening a dinner in honor of the national officers was attended by delegates and Tufts Chapter members. A public lecture followed, with Dr. George David Birkhoff delivering an address on "The Mathematical Nature of Modern Physical Theories."

NILS Y. WESSELL,
Secretary

SUMMER SESSION IN APPLIED MATHEMATICS AT BROWN UNIVERSITY

FOR the third summer, Brown University in its program of advanced instruction and research in mechanics, offers instruction and research direction in a twelve-weeks session beginning on June 14. A dozen graduate courses of a variety of grades are offered. These are largely in subjects related to mechanics, such as elasticity, fluid dynamics, theory of flight and partial differential equations; but there is one comprehensive course in mathematics of ultra-high frequencies in radio, which is particularly designed for those who expect to engage in research in that field. The staff in residence consists of Stefan Bergman, Lipman Bers, L. N. Brillouin, Willy Feller, G. E. Hay, Witold Hurewicz, P. W. Ketchum, Willy Prager and J. D. Tamarkin. In addition a dozen lectures each are scheduled for K. O. Friedrichs, R. E. von Mises and S. P. Timoshenko.

This program is supported by the U. S. Government, the Carnegie Corporation and the Rockefeller Foundation; tuition fees are remitted. There is an overwhelming demand from government agencies and industries for men from this school to do research in the mathematics underlying engineering.

Inquiries may be directed to the Dean of the Graduate School, Brown University, Providence, R. I.

THE COLUMBUS MEETING OF THE AMERICAN PHYSICAL SOCIETY

THE two hundred and fifty-fourth meeting of the American Physical Society will be held at the Ohio State University on April 30 and May 1. The departure from the Eastern seaboard is due to the unavailability of Washington and Baltimore, to the fact that the last meeting was in New York and the next one will be in Pennsylvania, and to the courtesy of the Ohio State University in offering its hospitality for the second time in less than four years. The meeting will be held jointly with the Ohio Section of the society and Section F (Physics) of the Ohio Academy of Science. The first session will begin at 10:30 o'clock on Friday morning. The headquarters hotel will be the Deshler-Wallick.

A lecture by Dr. Peter Debye, chairman of the department of chemistry of Cornell University, on "The Magnetic Approach to the Absolute Zero of Temperature" will be given at 8 o'clock on Thursday evening before the Ohio Chapter of Sigma Xi. Contributed ten-minute papers will be given in two sessions—on Friday morning at 10:30 and on Saturday afternoon at 2:00. An invited paper by K. Lark-Horovitz, head of the department of physics at Purdue University, on "Semi-Conductors: Their Properties and Their Uses" will be given on Friday afternoon at 2:00.

A part of the symposium in honor of Galileo (who died in 1642) and Newton (born in 1642), which was arranged by the American Association for the Advancement of Science for its New York meeting of December last and which was abandoned when that meeting was called off, will be given at the Columbus meeting through the courtesy of Professors Henry Crew and Louis T. More, who have consented to make available papers that were originally to have been read at the New York meeting. These will be presented on Friday afternoon, beginning at 3:30. Dr. Crew will speak on "Galileo, the Pioneer Physicist" and Dr. More will discuss "Newton's Philosophy of Nature."

A symposium on applied infra-red spectroscopy will be held on Saturday morning at 10:00. The speakers and their topics are: R. Bowling Barnes, American Cyanamid Company, "Applied Infra-Red Spectroscopy"; J. R. Downing, du Pont Experimental Station, "Applications of Infra-Red Spectroscopy to Chemical Research"; H. H. Nielsen and Ely E. Bell, of the Ohio State University, "Automatic Recording Vacuum Infra-Red Grating Spectrometer."

The annual dinner will be held at the Deshler-Wallick Hotel at seven o'clock on Friday evening, when Dr. Charles F. Kettering, of the General Motors Corporation, will speak on "Looking Forward through Research." Members and guests are requested to make advance reservations by letter or card addressed to Dean Alpheus W. Smith at the Mendenhall Laboratory of Physics, the Ohio State University, Columbus.

The council of the society will meet on Friday morn-

ing at 10:45. The annual luncheon for members and guests of the Sigma Pi Sigma, held in conjunction with the spring meeting of the society, will be given at 12:15 o'clock on Friday, April 30.

FIRST CHARLES L. MAYER AWARD OF THE NATIONAL SCIENCE FUND

Dr. Charles B. Huggins, professor of surgery at the University of Chicago, has been selected as the recipient of the prize of $2,000 given by Dr. Charles L. Mayer and administered by the National Science Fund of the National Academy of Sciences. The award was offered for the most outstanding contribution made during 1942 to present-day knowledge of factors affecting the growth of animal cells with particular reference to human cancer, and as a new type of prize for the advancement of fundamental scientific research administered under a new type of philanthropic foundation.

The advisory committee assisting the National Science Fund in selection of the prize winner consisted of Dr. George H. Whipple, dean of the School of Medicine and Dentistry of the University of Rochester, Nobel prize winner in medicine (joint award) in 1934; Dr. R. R. Williams, chemical director of the Bell Telephone Laboratories, discoverer of Vitamin B_1; Dr. Alan Gregg, director for the medical sciences of the Rockefeller Foundation, and Elihu Root, Jr. The committee decided that the 1942 award should go to Dr. Huggins for his studies of the human prostate, with special relation to the cancers taking origin from this gland. Dr. Huggins has shown that certain hormones ("chemical messengers" produced by the body), which regulate the normal activities of prostatic cells, have a marked influence as well on many of the cancers that derive from them. By the utilization of this knowledge he has been enabled to control the growth of the cancers and of such secondary tumors as may already have formed in distant organs. These discoveries have large theoretical as well as practical implications.

Dr. William J. Robbins, chairman of the National Science Fund and director of the New York Botanical Garden, said that formal presentation of the award will be made to Dr. Huggins later this spring at the annual dinner meeting of the board of directors of the fund. Dr. Robbins also announced that a second Charles L. Mayer award of $2,000 for an outstanding study made in the same field in 1943 will be given and that entries and recommendations for consideration for this award should be in the office of the National Science Fund, 515 Madison Avenue, New York City, by January 15, 1944. He also emphasized that the advisory committee is interested primarily in fundamental studies on the factors influencing growth of animal cells rather than applications to any particular aspect of normal or abnormal growth.

ELECTION OF FELLOWS OF THE ROYAL SOCIETY

The Royal Society, London, on March 18 elected the following scientific men into the Fellowship:

Bhatnagar, Shanti Swarupa, Kt. Director of scientific and industrial research, India. Distinguished for his numerous contributions to physical chemistry, more especially to magneto-chemistry. As professor of chemistry in the University of the Punjab he built up a flourishing school of research. Since the outbreak of war he has organized a new scientific department of the Government of India.

Buxton, Patrick Alfred. Director of the department of entomology, London School of Hygiene and Tropical Medicine. Distinguished for his researches in medical entomology with special reference to the conditions under which insects responsible for the transmission of diseases multiply and the measures which must accordingly be adopted for their control.

Daly, Ivan de Burgh. Professor of physiology, Edinburgh. Distinguished as an originator of essential items of modern physiological technique and for his important contributions to the physiology of the circulation in the lungs and the bronchial tubes.

Edgell, John Augustine, K.B.E. Vice-Admiral R.N. Hydrographer of the Royal Navy. Distinguished for the organization and encouragement of work in tidal research, in determining gravity at sea and in magnetic and electric survey of the oceans.

Ewins, Arthur James. Director of research, May and Baker Ltd. Distinguished for his chemical and biochemical researches. His work in organizing an industrial research laboratory has led to the production of some of the most important synthetic remedies in recent years.

Felix, Arthur. Bacteriologist, Lister Institute. Distinguished for his contributions to serology and bacteriology. He is particularly associated with the Weil-Felix reaction for the diagnosis of typhus fever and with the antigenic analysis of bacteria.

Fleming, Alexander. Professor of bacteriology, St. Mary's Hospital. Distinguished for his contributions to bacteriology, immunology and chemotherapy. His work includes the very important discoveries of lysozyme and penicillin.

Fox, John Jacob. Government chemist. Distinguished for his application of physical methods to the discovery of the structure of chemical substances and for his work on new analytical methods and chemical processes.

Greaves, William Michael Herbert. Astronomer Royal for Scotland. Distinguished for his contributions to stellar spectro-photometry and for the discussion of the color temperatures of early type stars.

Harland, Sidney Cross. Plant breeder. Distinguished for his contributions to the study of genetics and especially of the cotton plants. His researches have not only been of practical value for tropical agriculture but have led to

important advances in fundamental aspects of evolutionary theory.

Kon, George Armand Robert. Research professor of chemistry at the Royal Cancer Hospital. Distinguished for his researches in organic chemistry. During recent years his work on the polyterpenes has provided the basis for a number of important developments.

McCance, Andrew. Director and general manager, Messrs. Colville's Ltd., Motherwell. Distinguished for his work in the steel industry and particularly for his applications of physical chemistry to the processes of steel making.

Penfield, Wilder. Director of the Montreal Neurological Institute. Distinguished for his researches in neuro-histology and as a neuro-surgeon.

Pilgrim, Guy Ellcock. Formerly superintendent of the Geological Survey of India. Distinguished for his contributions to the geology of India, particularly in the field of Tertiary stratigraphy, and for his researches in vertebrate paleontology.

Stradling, Reginald Edward. Chief adviser, research and experiments department, Ministry of Home Security. Distinguished for his researches on the properties of building materials and for his direction of the Building and Road Research Stations and of the researches relating to civil defense.

Sykes, Charles. Superintendent of the metallurgy department of the National Physical Laboratory. Distinguished for his fundamental scientific research.

Synge, John Lighton. Professor of applied mathematics, Toronto. Distinguished for his contributions to mathematics, particularly to the geometry of dynamics, the theory of relativity, hydro-dynamics and electricity.

Temple, George Frederick James. Professor of mathematics, Kings College, London. Distinguished for his contributions to mathematical physics, particularly to quantum theory, relativity and mechanics.

Du Toit, Alexander Logie. Lately consulting geologist to the De Beers Consolidated Mines. Distinguished for his contributions to the geology and petrology of South Africa, particularly his work on the Karroo system and his comparative study of the equivalent succession of South America.

Zuckerman, Solly. Professor of anatomy, University of Birmingham. Distinguished for his studies on the morphology and relationship of the primates and on their reproductive physiology. He has also made outstanding contributions to the study of social behavior in the lower primates.

MEDAL DAY OF THE FRANKLIN INSTITUTE, PHILADELPHIA

Medal Day ceremonies of the Franklin Institute will be held on Wednesday evening, April 21, at half past five o'clock and will open with a reception to the medalists at which a portrait of Past-president P. C. Staples will be unveiled. A dinner and the presentation of awards will follow.

Certificate of Merit to Carl S. Hornberger, Central Scientific Company, Chicago. The Longstreth Medals jointly to Robert Griffin De La Mater and William Schwemlein, the Parkersburg Rig and Reel Company, W. Va. The Wetherill Medal to Robert Howland Leach, Vice-president, Handy and Harman, Bridgeport, Conn. The Brown Medal (posthumously) to Albert Kahn, Albert Kahn Associated Architects and Engineers, Inc., Detroit. Received by Mrs. Kahn. The Henderson Medal to Harry Miller Pflager, senior vice-president, General Steel Castings Corporation, Illinois. The Levy Medal to Anders Henrik Bull, assistant engineer, Board of Transportation of the City of New York. The Potts Medals to Francisco Ballén, director, National Guano Administration, Lima, Peru, and Paul Renno Heyl, National Bureau of Standards. The Cresson Medal to Charles Metcalf Allen, professor of hydraulic engineering, Worcester Polytechnic Institute. The Franklin Medal and Certificate of Honorary Membership to George Washington Pierce, Rumford professor of physics, emeritus, and Gordon McKay professor of communication engineering, emeritus, Harvard University, and to Harold Clayton Urey, professor of chemistry and executive officer, department of chemistry, Columbia University.

Following the presentation of the awards Dr. Pierce will make an address entitled "Songs of Insects" and Dr. Urey will speak on "The First Ten Years of Heavy Hydrogen."

SCIENTIFIC NOTES AND NEWS

Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, will deliver the Pilgrim Trust lecture at Burlington House, London, on May 6. The Pilgrim Trust sponsors an exchange of lectures on alternate years between the National Academy of Sciences and the Royal Society.

The Charles Frederick Chandler Medal, awarded annually by Columbia University for noted achievements in the field of chemistry, has been given this year to Willard H. Dow, of Midland, Mich., president of the Dow Chemical Company. The Chandler Medal was established in 1910 in honor of Professor Chandler, a pioneer in industrial chemistry. The presentation to Mr. Dow will take place on May 20 in Havemeyer Hall, when he will deliver the Chandler lecture.

The Egleston Medal of the Columbia University Engineering Schools Alumni Association has been awarded to Thomas H. Chilton, director of the technical division of the engineering department of E. I. du Pont de Nemours and Company, Wilmington, Del., for "distinguished engineering achievement." The award is made in recognition of "outstanding achievements in the discovery and formulation of principles underlying the unit operations of chemical engineer-

ing and in the application of these to process development, to equipment design and to chemical plant construction and operation." The presentation will be made at the seventy-second annual dinner of the engineering alumni on April 29.

The council of the Royal Society of Edinburgh has awarded the Makdougall-Brisbane Prize for 1938–1942 to Sir William Wright Smith, regius professor of botany at the University of Edinburgh, "for his papers within the period of the award, and in recognition of his valuable contributions to systematic botany."

The faculty of medicine of the University of Berne has conferred the degree of doctor of pharmacy, *honoris causa,* on Dr. Arthur Stoll, of Basle, in recognition of "his contributions to the chemistry of medicinal plants." Our correspondent writes that "Dr. Stoll was first to describe new methods to isolate active principles of drugs heretofore available only in the form of unstable galenicals. The isolation in pure form of such principles has not only widened their therapeutic application, but has opened entirely new indications owing to specific actions not obtainable with the crude drug (*i.e.,* ergotamine). This is the first time the faculty of medicine of the University of Berne has conferred this honorary degree."

It is stated in *Nature* that Dr. Leslie H. Lampitt, chief chemist and a director of Messrs. J. Lyons and Co., Ltd., has been awarded the medal of the Society of Chemical Industry, given for conspicuous services to the society. Dr. Lampitt has served on the council of the society for many years and has been its honorary foreign secretary and is now its honorary treasurer. He is also chairman of the Chemical Council. He has published many researches on foodstuffs.

The Council of the British Institution of Naval Architects has awarded the Gold Medal of the institution for the year 1942 to W. C. S. Wigley, for his paper "Calculated and Measured Wave Resistance of a Series of Forms Defined Algebraically, the Prismatic Coefficient and Angle of Entrance being Varied Independently." The Wakeham Prize for 1942 has been awarded to N. Hancock for his paper, "Blade Thickness of Wide-Bladed Propellers."

The American Association of Dental Schools has elected the following officers: *President,* Allen T. Newman, of New York University; *President-elect,* F. W. Hinds, of Baylor University; *Vice-president,* Alvin W. Bryan, of the State University of Iowa. Carl O. Flagstad, of the University of Minnesota, was reelected secretary-treasurer. The 1944 meeting will be held at the Drake Hotel, Chicago.

Dr. Jurgen Ruesch, of Zurich and Basle, has been appointed lecturer in psychiatry at the Medical School of the University of California, San Francisco. Since the outbreak of the war he has held a Rockefeller Foundation fellowship and has been working in Boston hospitals and at the Harvard Medical School.

Dr. David L. Coffin, instructor in veterinary pathology at the University of Pennsylvania, has been appointed to the Herbert Fox Memorial Fellowship in comparative pathology at the Zoological Society of Philadelphia. Dr. Coffin, who is the first incumbent of the fellowship, will serve as assistant to Dr. Herbert L. Ratcliffe, recently appointed director of the Penrose Research Laboratory of the Zoological Society and assistant professor of comparative pathology at the University of Pennsylvania.

Dr. Edgar C. Bain, a member of the research staff of the U. S. Steel Corporation since 1928, has been appointed vice-president of the Carnegie-Illinois Steel Corporation, principal subsidiary of the U. S. Steel Corporation, in charge of research and technology. Dr. Bain is an authority on alloy steels.

Colonel James Stevens Simmons, director of the Division of Preventive Medicine, Office of the Surgeon General, U. S. Army, has been made a brigadier general with rank from March 14.

Malcolm E. Campbell, senior cotton technologist in charge of the technical research program of the cotton and fiber branch of the Department of Agriculture, has joined the staff of the Textile Research Institute, Inc., where he will supervise applied and cooperative research activities.

Dr. Gaylord W. Anderson, on leave from his post as head of the division of preventive medicine and public health of the Medical School of the University of Minnesota to serve in the Office of the Surgeon General of the Army, has been made head of the division of medical intelligence. The division compiles health, climatic and sanitation evidence with respect to every area to which United States troops may be sent and stands ready at a moment's notice to supply such information to the medical officers of detachments sent anywhere in the world. Such matters as the types of insects, snakes and other possibly dangerous creatures, diseases peculiar to the area, degrees of heat and humidity, poisonous plants, necessary dietary precautions, probable purity of the water supply and the like are included in comprehensive surveys.

It is reported in the daily press that Professor Ray G. Johnson, head of the department of animal husbandry of Oregon State College, has arrived in Chungking at the invitation of the Chinese Ministry of Education. He will give a series of lectures on animal

husbandry in various universities and colleges in Free China and will make an extensive tour of the Northwest, where he will study the development of animal husbandry.

THE nineteenth Lewis Linn McArthur Lecture of the Frank Billings Foundation of the Institute of Medicine of Chicago will be delivered at the Palmer House on Friday evening, April 23, by Dr. Chester M. Jones, of the Massachusetts General Hospital, Boston. He will speak on "The Relationship between the Nervous System and Pain Perception with Particular Reference to the Gastro-intestinal Tract."

THE commencement address at the Hahnemann Medical College and Hospital was given on March 25 by Dr. Haven Emerson, professor of public health, Columbia University.

DR. WILLIAM E. LADD, professor of child surgery, Harvard Medical School, Boston, delivered the first Béla Schick Lecture at Mount Sinai Hospital on April 13. His subject was "Time and Choice of Operation in Early Life." The lecture is one of a series planned in honor of Dr. Béla Schick, now consultant and formerly pediatrician in chief at the Mount Sinai Hospital and is made possible by a fund contributed in 1942 by his friends and associates.

THE annual Hughlings Jackson Memorial Lecture of the Montreal Neurological Institute will be given on April 28 by Professor Philip Bard, of the department of physiology of the Johns Hopkins Medical School. The title of the lecture will be "Re-representation as a Principle of Central Nervous Organization."

THE Association of Southeastern Biologists will not hold its annual meeting this spring. Dr. Mary S. MacDougall is president and Dr. Martin D. Young, of the U. S. Public Health Service, Columbia, S. C., has been elected secretary-treasurer.

THE March number of *The American Journal of Physical Anthropology,* which has just appeared, marks the beginning of a new series under a new editor. Dr. Aleš Hrdlička, who founded the journal in 1918 and carried it through the first twenty-nine volumes, has resigned in favor of an editorial board representing the American Association of Physical Anthropologists. This board consists of Dr. T. D. Stewart, of the U. S. National Museum, *Managing Editor;* Dr. Mildred Trotter, of Washington University; Dr. Wilton M. Krogman, of the University of Chicago; Dr. William W. Greulich, of Western Reserve University, and Dr. Carl C. Seltzer, of Harvard University, *Associate Editors.*

YALE UNIVERSITY has established eight research fellowships amounting to $20,000 for the year beginning July 1. The fellowships, which are in the field of the humanities and sciences, are under the auspices of the Committee on Liberal Studies under the chairmanship of Professor Chauncey B. Tinker. They will be open to young scholars of the United States or Canada for a year's research at Yale and will pay the recipient $2,500 a year. Although the normal appointment for these fellowships is a full academic year (ending in July, 1944), applications are nevertheless accepted from qualified men and women who may be able to spend only a part of the year upon the fellowship. Applicants should possess the Ph.D. degree, and preference will be shown to those who have demonstrated a capacity for independent research. Applications should be addressed to the Dean of the Graduate School at Yale and must be received on or before May 10. Announcements of awards will be made on May 20.

A GIFT is announced of about $50,000 to the Medical School of Tufts College from Dr. and Mrs. George G. Averill, of Waterville, Me. Dr. Averill, who is a graduate of the school, had previously made a similar contribution.

GIFTS amounting to nearly $80,000 were made to New York University during February and March. The largest single item was $17,625, which was contributed by alumni and friends of the College of Medicine through Dean Currier McEwen towards an emergency fund made necessary by the accelerated program of training physicians for the war effort. Other alumni contributed $5,000, through the Alumni Fund, toward general university expenses. The sum of $48,844 was contributed to the College of Medicine, much of it for research in such fields as metabolism, nutrition, neurology, psychiatry, anesthesia and surgery, the need for which has been stimulated by the war. Gifts were reported from the Williams and Waterman Fund of the Research Corporation, the Lucius N. Littauer Foundation, Inc., the Carnegie Corporation, Josiah Macy, Jr., Foundation, the National Committee for Mental Hygiene and many others.

THE Johns Hopkins University has established a special course to train technicians in the use of industrial instruments and controls. The Brown Instrument division of the Minneapolis-Honeywell Regulator Company is cooperating in the program by assigning as guest lecturers members of its Philadelphia technical staff. They will explain the working of such instruments as the recently developed electronic potentiometer, the Radiamatic pyrometer and air-operated process controls. Sixty picked men from war plants in this area are attending the classes, which include both lectures and laboratory instruction in the principles of temperature measurement and use

and maintenance of control instruments. They are under the direction of Dr. R. B. Anderson.

THE first completed section of the Hall of New World Archeology was opened to the public at Field Museum of Natural History early this year. According to Dr. Paul S. Martin, chief curator of the department of anthropology, under whose supervision the new exhibits were designed and prepared, the hall marks the beginning of an era of improved techniques in the exhibition of anthropological material. The material used is largely from expeditions conducted by Dr. Martin and associated archeologists. The section now being opened bears the title "Indian America," and presents "streamlined" exhibits of the New World civilizations as the white men found them when they invaded the western hemisphere. Later, other sections of the hall will be completed. Besides Dr. Martin members of the museum staff who played an important part in the planning of the hall are Donald Collier, assistant curator of North American archeology; Mrs. Alexander Spoehr, artist, and Alfred Lee Rowell, dioramist. Dr. Alexander Spoehr, assistant curator of North American ethnology and archeology, also had a great deal to do with the conception and preparation of the hall, but he is now on leave of absence from the museum as an ensign in the U. S. Navy. Another staff member, Dr. John Rinaldo, research associate, who made contributions to the new exhibits, is serving in the Army as a staff sergeant.

THE British Secretary for the Colonies, according to *The Times*, London, has approved a recommendation of the Colonial Advisory Council of Agriculture and Animal Health that its functions should be extended to include forestry. The council will accordingly in future be known as the Colonial Advisory Council of Agriculture, Animal Health and Forestry. Additional members will be appointed to the council to advise on forestry matters, and a Forestry Committee will shortly be set up. The Duke of Devonshire, as successor to Harold Macmillan, Parliamentary under-secretary for the Colonies, has assumed chairmanship of this council; the vice-chairman is G. L. M. Clauson, assistant under-secretary.

DISCUSSION

THE COMPLEX VITAMIN B COMPLEX

THE existence of thirteen vitamins is now commonly accepted. Of these, eight are members of the so-called vitamin B complex. Of the latter group thiamine (B_1), riboflavin (B_2), pyridoxine (B_6), nicotinic acid, pantothenic acid and biotin are recognized as vitamins by all workers, but there is not complete agreement as to whether inositol and choline (or a choline-like factor) should be so classified. The status of para-aminobenzoic acid as a vitamin still is indefinite.

During comparatively recent years, discoveries of more than twenty additional B vitamins have been announced from competent laboratories. Some of these, however, have been eliminated by the isolation of the eight members referred to above. That seems to have been the case with vitamins B_3, B_4 and B_5. This elimination process no doubt will be applied to other B vitamin designations.

The isolation of a new vitamin is important for several reasons: (1) it adds to our knowledge of nutrition, (2) it offers hope of chemical identification and synthesis of the compound, (3) it makes possible further advances through incorporation of the pure vitamin into synthetic diets and (4) it simplifies the list of vitamins by eliminating some of those previously announced.

Early in 1940 it was reported from the laboratory of one of us[1] that under certain dietary conditions chicks grow slowly, and develop a severe anemia which can be cured with liver extracts. The responsible factor was recognized as an unidentified member of the B complex and for convenience it was designated as vitamin B_c.

Although other factors required for the growth of the chick have been announced (factors U, R, S and the norit eluate factor) the anemic condition in relation to vitamin B deficiency has not been observed by others prior to 1942. Recently, however, Mills, Briggs, Elvehjem and Hart[2] have verified this claim. They state that "the occurrence of anemia on our basal ration and its prevention by the norite eluate factor is suggestive of the identity of the norit eluate fraction with Hogan's antianemic factor." They also point out that the factors listed above, together with "folic acid," possess certain similarities.

Since the 1940 reports, research workers in our laboratories have consistently verified the claims made in respect to vitamin B_c and have extended the work. The first of their joint progress reports appears in this number of SCIENCE and as a result of that, and of future publications, it is reasonable to expect a simplification of the vitamin B problem.

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OLIVER KAMM

PARKE, DAVIS AND COMPANY,
DETROIT, MICH.

[1] A. G. Hogan and E. M. Parrott, *Jour. Biol. Chem.*, 132: 507, 1940.

[2] R. C. Mills, G. M. Briggs, Jr., C. A. Elvehjem and E. B. Hart, *Proc. Soc. Exper. Biol. and Med.*, 49: 186, 1942.

PHENOTHIAZINE FOR CATTLE LICE CONTROL

SUCCESSIVE trials using phenothiazine as a dust has proven this compound to be very effective against the short-nosed cattle louse, *Haematopinus eurysternus* (Nitzsch), and the long-nosed cattle louse *Linognathus vituli* (Linné). The insecticide, diluted with equal parts of white flour, was applied to twelve infested animals located in various parts of North Dakota. A 100 per cent. mortality of these sucking lice was obtained in every trial. It failed to kill, however, the chewing cattle louse, *Bovicola bovis* (Linné). Twelve hours after applying this mixture to two heavily infested bulls the chewing lice had discontinued feeding and were scattered throughout the hair; however, when the animals were examined the following day the lice had moved to the skin and were actively feeding. A mixture of sodium fluosilicate two parts, phenothiazine one part, and white flour one part, gave excellent control of both sucking and chewing types of lice. It is entirely possible that effective control may be achieved by increasing the diluent and decreasing the amount of phenothiazine or sodium fluosilicate. This phase of experimentation is now under way at the North Dakota Agricultural Experiment Station. In view of the limited supplies of rotenone and pyrethrin, both effective louse powders, this phenothiazine dusting mixture may replace these imported insecticides.

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EARLY AND LATE EASTER DATES

MARCH 24 is the most unusual Gregorian Easter date. Three years ago, in 1940, it occurred for the second time since the Gregorian calendar reform (1582). An interval of 451 years separates 1940 from 2391, the next year having March 24 as the Gregorian Easter date.

March 22 is the earliest possible Easter date. Although it occurred four times since the calendar reform, a record interval of 467 years will elapse between 1818 and 2285, the years of the latest and of the next return of March 22 as the Gregorian Easter date.

April 25 is the latest possible Easter date. Between the time of the Gregorian reform and the end of the nineteenth century, all the possible Easter dates—except March 24 and April 25—had occurred at least four times. In 1943, Easter Sunday will fall, for the fourth time, on April 25 in the Gregorian calendar. If one of the current calendar reform projects—all of which object to late Easter dates—should be adopted within the lifetime of the next two or three generations, April 25, 1943, may mark the last occurrence of this latest possible Easter date.

GREGORIAN EASTER DATES[1]

March 22	March 23	March 24	April 24	April 25
1598				
1693	1636		1639	1666
	1704		1707	1734
1761	1788	1799	1791	
1818	1845		1859	
	1856			1886
	1913	1940		1943
	2008		2011	2038
			2095	
	2160		2163	2190
2285	2228		2231	2258
2353	2380	2391	2383	2326

ALEXANDER POGO

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SPECIAL CORRESPONDENCE

THE WORK OF SOVIET BOTANISTS[1]

THE war, demanding a tremendous concentration of the forces of the whole people of the U.S.S.R., has also put forward a number of problems to be solved by the botanists. First and foremost, the huge expenditure of bandaging materials made it necessary for us to search for other than the raw materials ordinarily used for this purpose. In Russia and in a number of other countries during the World War of 1914–1918, sphagnum (peat bog moss) was used for this purpose.

At the very beginning of this war, work on the study and preparation of sphagnum was begun by the Institute of Botany of the Academy of Sciences of the U.S.S.R. situated in Leningrad. Large quantities of sphagnum were easily available in numerous peat bogs in the Leningrad district. Sphagnum, thanks to the peculiar structure of its cells, has excellent absorbent qualities. The moss is carefully cleaned of all extraneous matter, dried, steam sterilized and made into gauze-covered pads of various sizes.

Experience has shown that wounds heal much more

[1] Radioed to the American Association of Scientific Workers by Sergei Pilipchuk, secretary of the Soviet Scientists Antifascist Committee and forwarded to SCIENCE by Dr. Harry Grundfest, of the Rockefeller Institute.

[1] In the table published in SCIENCE, 91: 292, 1940, two dates have been inadvertently omitted.

quickly with sphagnum bandages than with cotton-batting bandages. This is explained by the fact that, in addition to its draining qualities, the moss also contains certain disinfecting substances.

Under the guidance of botanists, large quantities of sphagnum bandages were prepared for the Leningrad front, and a short pamphlet on the gathering and preparation of moss was printed. Sphagnum is now prepared on a large scale in the northern regions of the Soviet Union.

Another item of interest to botanists was the preparation of fir balsam from the sap of fir trees. This balsam, mixed with other substances, has been used in many Leningrad hospitals for treatment of fresh wounds. The demand for this balsam is increasing rapidly as doctors are becoming acquainted with its use and its qualities. The number of fir trees in Siberia and the northern regions of European Russia is enormous and fir balsam can be prepared in unlimited quantities.

The search for vitamin-bearing plants has also given botanists a large amount of wartime work. Everybody knows the value of vitamins to the human organism, but in wartime these substances are more than ever essential. One of the most important of these substances is vitamin C. Even before the war it was known that one of the richest sources of vitamin C is the wild rose hip. Since the war, vitamin contents of hips in the eastern and northern districts of the U.S.S.R. have been studied to discover where the vitamin content is greatest. In some places wild roses have been planted in order to produce hips rich in vitamin. The collection and delivery of hips has been organized on a large scale. Hips of certain roses of Central Asia have been found particularly rich in vitamins and these sorts are being specially cultivated.

It has recently been discovered that green unripe walnuts growing in dense forests in Central Asia also contain vitamin C. Collection of these nuts and manufacture of vitamin-bearing preparations had been organized.

Quite recently it was discovered that needles of ordinary pine trees contain large quantities of vitamin C. Biochemists in Moscow and Leningrad have organized mass production of vitamin C concentrate from pine needles. Despite the fact that the percentage of vitamin contained in needles is very small, this source of vitamin C is of particular value to us on account of the huge pine forests throughout the whole territory of the Soviet Union with the exception of the Arctic and desert regions.

During the long siege of Leningrad lack of vitamin C made itself particularly felt, and the decoction made from pine needles played an important role in the prevention of scurvy. In its impure state the liquid has a bitter flavor, but a number of proposals have already been made for freeing the liquid of its bitterness. Since the war began, a number of grasses have also been discovered to contain vitamin C.

Botanists have taken an active part in gathering wild medicinal plants; in cultivation of plants for the manufacture of insecticides; and in the discovery of new plants which might be used medicinally.

Attention has also been paid to a number of wild plants which can be used as salads, for example, the dandelion, primrose, etc. Attention has also been devoted to the roots of other plants rich in starch and inulin, and to fruits of a number of wild trees and shrubs such as bird cherry, hawthorn and rowan. A flour is produced from dried rowan berries which may be added to ordinary flour in proportion up to 25 per cent. and used for baking pastry, etc. Flour made from bird cherries gave excellent results in cakes. These are all results of work done by botanists to help the inhabitants of Leningrad during the siege of last winter.

Much has also been done to find substitutes for tea and coffee among wild-growing flowers. One item of particular interest is the publication of an illustrated pamphlet for guerillas and raiding troops operating behind enemy lines, giving details of all wild-growing edible plants.

These are some of the ways in which botanists are employing their science in the service of the great cause of the war against Hitlerism.

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SCIENTIFIC BOOKS

ORGANIC CHEMISTRY[1]

Organic Chemistry. By W. T. CALDWELL. 760 pp. Houghton, Mifflin Company. $4.25.

THIS is an excellent text. It is carefully written and each subject is dovetailed into the following one with clear argument, proper insistence, repetition and reference, and with a cunning use of items of historical interest, a use which argues authorship by a person who delights in exposition as an art. The printing is well done, the formulae are clear, the pages please the eye and the reading pleases the mind. It is remarkable not only for the arrangement and style but also for its comprehensiveness and accuracy. It is thoroughly up-to-date and yet never fails to place the newer items of theoretical or practical interest in

[1] Corrected proof was received shortly before the recent death of Dr. Powell.

a framework which does not exaggerate their importance. This is an item too often neglected and it argues much for the sincerity of the author that he takes upon himself such obligation of balancing the new and spectacular against the old and dulled. It is suitable for a three-semester course in organic chemistry and yet so arranged that it can be left safely in the hands of a student for general reading preparatory to advanced work. No literature references or questions are included in the text and the saving of space so achieved is turned to good purpose in the inclusion of material and argument. This reviewer hopes that the merit of the work will be rewarded with widespread use. It is deserving of the widest support and is the best general text in organic chemistry that he has seen for many years.

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BLOOD GROUPING

Blood Grouping Technic. By F. SCHIFF and W. C. BOYD. Interscience Press, 1942.

THIS book by two outstanding investigators in the field of blood grouping is an authoritative compilation of methods of grouping, based in large degree on the experience of the authors themselves. While the book is supposed to be a translation and amplification of Schiff's small manual which enjoyed a well-deserved popularity for a long time in Germany, it is really a new book. The arrangement of the material is quite different and the book is nearly three times as large as the German manual on account of the inclusion of much new material. It is unfortunate that Dr. Schiff did not live to see this fine book in print, but the work was capably brought to its completion by Dr. Boyd.

The monograph opens with a brief introductory chapter outlining what is known of the individual differences in human blood and the secreting factor. In the succeeding extensive chapter, the general technic of blood grouping is described in great detail, including methods for determining the four blood groups, the subgroups of groups A and AB, the M-N types and the Rh-type. Detailed instructions are given for carrying out tests not only on blood by direct agglutination and hemolysis, but also on organs and secretions by the technics of absorption, inhibition and complement fixation. In addition, full directions are given for the preparation of suitable grouping sera, including immune sera in rabbits against agglutinogens A, B, M and N. In the remaining chapters of the book, further refinements in the technic are presented from the point of view of the specialized requirements in relation to the practical applications of the tests in blood transfusion, in forensic medicine in cases of disputed parentage and for the examination of blood stains and in anthropology.

Of considerable interest is the section discussing the anthropological significance of the blood groups, especially since Dr. Boyd has made significant contributions to this subject. Among the theories mentioned to explain the differences in the present distributions of the blood groups genes throughout the world the most plausible is that favored by Bernstein and Candela that there were originally two or more races, each belonging predominantly to one or two of the four blood groups, and that the present distribution in white races arose by crossing between the original races. Boyd himself, however, proposes a monophyletic theory and postulates that man originally had a blood group distribution represented approximately by the frequencies p $(A) = 0.35$, q $(B) = 0.15$ and r $(O) = 0.65$, and that as man spread to the four corners of the world, isolated groups by chance lost largely one or two of the three genes. The weak point in this theory is that no attempt is made to explain how the original blood group distribution arose, nor to apply to man the observations on apes and lower monkeys. To the reviewer the polemic between the sponsors of the monophyletic and polyphyletic theories appears largely academic, since undoubtedly numerous times in man's history there must have been periods of migration, isolation and inbreeding succeeded by periods of invasion and mixing of races. Accordingly, as the authors of the manual will probably agree, the choice between the two theories would depend to a great extent on the time selected as the onset of man's history as a distinct species.

All in all this book on blood grouping technic constitutes a valuable contribution and one destined to serve as a standard and authoritative reference work on the subject for a long time to come.

A. S. WIENER

SPECIAL ARTICLES

ENZYME SYSTEMS CONTAINING ACTIVE SULFHYDRYL GROUPS. THE ROLE OF GLUTATHIONE[1]

UP to now there has been published scattered information on this subject, and from time to time there have appeared observations on the presence of -SH groups essential for enzyme activity among some hydrolytic enzymes, certain lipid-splitting enzymes, several pneumococcal and streptococcal hemolysins, and a few oxidation enzymes. A comprehensive study of the presence of -SH groups essential for

[1] From the Chemical Division, Department of Medicine, the University of Chicago.

enzyme activity was considered therefore necessary. The activity of the enzyme systems was measured in the presence of iodoacetamide, chloromercuribenzoic acid and organic arsenicals.[2] Reactivation was studied by addition of glutathione after the enzyme had remained in contact with the inhibitor for about 20 minutes.

Enzymes for Carbohydrate Metabolism: Some evidence for the presence of -SH groups in pyruvate oxidase could be found in the inhibition produced by 2,6-dichlorophenol indophenol, and quinone reported by Barron[3] and in the increase of the rate of pyruvate oxidation and of acetoacetate synthesis by ground avian liver on addition of glutathione (Table I). The presence of -SH groups in the protein seems necessary not only for pyruvate oxidation, but also for pyruvate dismutation, and pyruvate condensation (CO_2 fixation ?), (Table II). In these experiments, pyruvate oxidation was determined by measurement of O_2 uptake; dismutation by measurement of CO_2 production in bicarbonate-Ringer and $N_2 : CO_2$ as gas phase; and condensation by measurement of ketoglutarate, aceto-acetate, acetyl methylcarbinol and carbohydrate synthesis. Iodoacetamide, chloromercuribenzoic acid and organic arsenicals inhibited these reactions; glutathione reactivated them. Besides pyruvate, the oxidation of malate and of ketoglutarate were inhibited by these reagents and reactivated by glutathione.

TABLE I

THE EFFECT OF GLUTATHIONE (GSH) (0.01 *M*) ON THE OXIDATION OF PYRUVATE AND ON THE FORMATION OF ACETO-ACETATE

FIGURES GIVE CMM. PER HR. GROUND PIGEON LIVER; BUFFER, NACL-PHOSPHATE, PH 7.4; CONCENTRATION OF PYRUVATE, 0.01 M

	Control	GSH
O_2 uptake	241	371
Pyruvate utilization	174	378
Aceto-acetate formation	40.2	114.6

Native myosine (adenosine triphosphatase) was inhibited by chloromercuribenzoic acid and reactivated by glutathione.

Enzymes for Nitrogen Metabolism: d-Amino acid oxidase, 1-glutamic acid oxidase, monoamine oxidase and transaminase were inhibited by iodoacetamide, chloromercuribenzoic acid and trivalent arsenicals, and reactivated by glutathione (Table II). Diamine oxidase was not inhibited by these -SH reagents.

TABLE II

ENZYME SYSTEMS CONTAINING ACTIVE -SH GROUPS THEIR INHIBITION WITH IODOACETAMIDE (0.001 *M*), CHLOROMERCURIBENZOIC ACID (0.001 *M*), AND ORGANIC TRIVALENT ARSENICALS (0.0001 *M*), AND THEIR REACTIVATION WITH GLUTATHIONE (0.01 *M*)

Enzyme system	Inhibition (per cent.)			Reactivation (per cent.)
	Iodo-acet-amide	ClHg benzoic acid	Organic arseni-cal	Gluta-thione
Carbohydrate metabolism				
Pyruvate oxidation	80	92	87	41
Pyruvate condensation (α ketoglutarate synthesis)			87	
Pyruvate condensation (acetoacetate synthesis)			63.5	complete
Pyruvate condensation (carbohydrate synthesis)			95	93
Pyruvate dismutation		96	35.6	93
Pyruvate condensation (acetyl methyl carbinol formation	64.5	85	56	complete
α Ketoglutarate oxidation	90	70	98.5	98
Malate oxidation		complete	69.5	80
Native Myosine (adenosine triphosphatase)		90		complete
Nitrogen metabolism				
d-amino acid oxidase		complete	90	78
l-glutamate oxidase	none	87		90
Transaminase		49	81	95
Monoamine oxidase	33.3	82	71	complete
Fat metabolism				
Stearate oxidase (liver)	30	complete	complete	
Stearate oxidase (bacteria)	80	complete	72	
Oleate oxidase (bacteria)	52	complete	complete	
β Hydroxybutyrate oxidase (heart)		complete	complete	complete
Lipase	none	38	62	72

Enzymes for Alcohol Oxidation: Dixon[4] found that the oxidation of ethyl alcohol by yeast alcohol oxidase was inhibited by iodoacetate while its oxidation by liver alcohol oxidase was not affected. The same results were found by using the purified activating proteins and measuring the rate of diphosphopyridine nucleotide reduction.

The oxidation of choline by liver choline oxidase was found by Block and Barron[5] to contain -SH groups essential for activity. Similar findings were observed on the oxidation of glycerol by bacteria.[6]

Enzymes for Fat Metabolism: The presence of -SH groups was found necessary for the activity of the following enzymes concerned with the metabolism of fats: the oxidation of stearate by rat liver extract, and by bacteria (*B. coli*), the oxidation of β hydroxybutrate by animal tissues. Pancreatic lipase was partially inhibited by chloromercuribenzoic acid and by organic arsenic while it was not affected by iodoacetamide (Table II). In these experiments, the oxidation of stearate was measured by the O_2 uptake; the oxidation of β hydroxybutyrate, by the rate of reduction of diphosphopyridine neucleotide; pancreatic lipase activity by titration with NaOH.

[2] The organic arsenicals used were: p-carboxyphenyl arsine oxide, 3-amino, 4-hydroxy phenyl-dichloro-arsine HCl, p-amino phenyl dichloro-arsine HCl, p-carbamylphenyl arsine oxide, and p-arsine oxide, kindly furnished by Dr. Harry Eagle. p-Chloromercuribenzoic acid was kindly provided by Dr. L. Hellerman.

[3] E. S. G. Barron, *Jour. Biol. Chem.*, 113: 695, 1936.

[4] M. Dixon, *Nature*, 140: 806, 1940.

[5] B. Block and E. S. G. Barron. To be published.

[6] E. S. G. Barron, *Bol. Soc. Quim. Peru*, 6: 7, 1940.

Esterases: Nachmanson[7] has shown that acetyl choline esterase is inhibited by mild oxidizing agents and iodoacetic acid. In agreement with these findings, 3-amino-4-hydroxyphenyl arsine oxide (6.6×10^{-5} M) produced 57 per cent. inhibition. In contrast with this esterase, the hydrolysis of mono-n-butyrin by human serum esterase was inhibited by ClHg benzoic acid by only 18 per cent., addition of glutathione bringing partial reactivation; hog liver esterase was inhibited by 31 per cent. with p-carbamyl phenyl arsine oxide, and by 9 per cent. with ClHg benzoic acid; pancreatic esterase was not affected by the -SH reagents.

Proteins containing no -SH groups essential for enzymatic activity: The following enzymes were not affected by the above-mentioned -SH reagents: polyphenol oxidase, arginase, citric oxidase, uricase, catalase, lactic oxidase, liver alcohol oxidase, histaminase, potato phosphorylase, carbonic anhydrase, acid phosphatase, peanut fat oxidase, pepsin, cytochrome oxidase and flavoproteins.

Since such a large number of enzyme systems contain in their protein moiety -SH groups essential for enzyme activity, the role of glutathione becomes of great importance. Glutathione, by maintaining these groups in their reduced form would maintain the enzyme activity of those systems possessing essential -SH groups.

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AUXIN ACTION

MUCH is already known about the results of the action of auxins and similarly behaving compounds in inducing roots to grow on cuttings, in producing parthenocarpy and in affecting the growth of the whole plant, especially at the tips of herbaceous stems where growth activity is most intense. However, the fundamental mechanism is still to be revealed. The purpose of this article is to make known that discovery and to support it with sound evidence.

The mechanism is fundamentally the release of diastase, and possibly sucrase and other enzymes, from the protein colloidal substances to which they are normally attached. Enzymes are partly and considerably inactivated by adsorption onto a colloid as shown by Eyster.[1] A 100 ml solution containing 50 ml 1 per cent. soluble starch and 5 ml 1 per cent. diastase (Merck) and enough water to make a total volume of 100 ml required only 15 minutes for digestion past the last iodine staining stage as shown by the I_2KI test. A similar solution with 1 gram of dry activated charcoal, added immediately after the diastase was added, required 234 minutes (almost four hours). While ethyl alcohol, ether and chloroform decreased slightly the enzymatic activity of diastase in the absence of a colloidal carrier, they markedly accelerated the activity in the presence of charcoal. This indicates that the narcotics had a stronger influence in releasing the diastase from the charcoal (*i.e.,* enzyme from colloid) than it had in reducing the actual digestive action of the unbound enzyme. It was concluded that associated colloids dominate the effects of chemical agents and of environmental factors on enzymes.

Indole-3-acetic acid, β-(indole-3)-propionic acid, γ-(indole-3)-n-butyric acid and α-naphthaleneacetic acid increase the action of diastase when associated with activated charcoal in proportion to their concentrations. Table 1 presents the data for indole-propionic acid, which was being used at the time of the discovery of the mechanism of growth substances. In each case 50 ml of 1 per cent. soluble starch solution, 5 ml of 1 per cent. diastase solution, and enough indole-propionic acid to give the stated concentration were diluted to 100 ml with distilled water. The concentration of indole-propionic acid is based on the final solution volume of 100 ml. The diastase solution was added last and then there followed immediately the addition of exactly 1 gram of dry charcoal. Each mixture was placed in 125 ml bottles. The temperature of the room and of the component solutions before mixing was close to 25° C. The experiment was done in the evening in the presence of four functioning 100-watt electric light bulbs at an average distance of 8 feet. The influence of light will be clarified later in this article.

TABLE 1

INFLUENCE OF VARIOUS CONCENTRATIONS OF INDOLE-PROPIONIC ACID ON THE ENZYMATIC ACTION OF DIASTASE ASSOCIATED WITH CHARCOAL

Concentration of indole-propionic acid	Time required for digestion of soluble starch past the last iodine staining stage
0 parts per million	265 minutes
5 " " "	252 "
10 " " "	245 "
25 " " "	230 "
50 " " "	188 "
75 " " "	160 "
100 " " "	126 "
150 " " "	60 "

Table 2 presents data to show the effect of indole-propionic acid on isolated diastase; *i.e.,* diastase in the absence of charcoal. In this case 50 ml of 1 per cent. soluble starch solution, 1 ml of 1 per cent. diastase solution and enough indole-propionic acid to give the stated concentration were diluted to 100 ml. No charcoal was added. The conditions of temperature and light were the same as in the preceding ex-

[7] D. Nachmanson and E. Lederer, *Bull. Soc. Chem. Biol.,* 21: 797, 1939.

[1] *Plant Physiology,* 18: in press.

periment. Indole-propionic acid retards the action of the diastase in direct proportion to its concentrations. This explains the inhibiting effect of auxin in starch or sucrose free organs, such as some roots. Roots containing starch or sucrose would be expected to, possibly, show a stimulation in growth upon the addition of auxin. It is also expected that organs containing starch or sucrose but with an ample supply of unbound enzyme are inhibited in their growth in the presence of additional auxin.

TABLE 2

INFLUENCE OF VARIOUS CONCENTRATIONS OF INDOLE-PROPIONIC ACID ON THE ENZYMATIC ACTION OF DIASTASE NOT ASSOCIATED WITH CHARCOAL

Concentration of indole-propionic acid	Time required for digestion of soluble starch past the last iodine staining stage
0 parts per million	105 minutes
5 " " "	112 "
10 " " "	117 "
25 " " "	130 "
50 " " "	150 "
75 " " "	172 "
100 " " "	195 "
150 " " "	235 "

Phototropism can be demonstrated by running a series of charcoal-diastase-soluble starch mixtures in varying light intensities, inasmuch as the charcoal system is extremely sensitive to light. Light accelerates the rapidity with which the enzymes are bound to the colloid. The mixtures were similar to those

TABLE 3

INFLUENCE OF VARIOUS INTENSITIES OF LIGHT ON THE ENZYMATIC ACTION OF DIASTASE ASSOCIATED WITH CHARCOAL

Condition of light	Time required for digestion of soluble starch past the last iodine staining stage
Total darkness	234 minutes
Artificial light at night	265 "
Weak diffuse natural light in day	415 "
Strong diffuse natural light in day	605 "

used in Table 1, except no auxin was added. Table 3 presents the data.

Daylight with its ultra-violet and blue-indigo-violet light components is very potent in accelerating the rapidity with which enzymes are bound to a colloidal carrier, consequently making the enzymes less free to act. Artificial light has very little influence, as expressed also in its reaction on growth of plants. Since there was more rapid digestion by the charcoal-bound diastase in the dark than in the light, this explains the greater growth of the stem tip on the shaded side than on the illuminated side. Growth substances merely aid in releasing the enzyme from the colloid, especially after it has been rather securely adsorbed by the influence of many continuous hours of strong natural illumination. This explains why growth substances are not specific, but include a great variety of substances from the indole compounds to ethylene and carbon monoxide. Any substance which releases the digestive enzyme from its colloidal carrier, or slows the rate at which the enzymes are being bound to the colloid, without unduly upsetting any vital process, can apparently act as a growth substance. The indole compounds are more satisfactory because they are milder in their effect. They liberate sufficient enzyme to bring about the formation of digested foods in a quantity large enough to prevent suitable forms of food from being a limiting factor, and still just mildly affect membrane permeability and other cellular properties and functions.

Light is effective in building up food reserves for the plant, and in causing the digestive enzymes to be bound to their colloidal carriers more securely. Auxin releases the enzyme from its colloidal base and makes it free to act. Indications are both that in phototropism the auxin does not shift from the illuminated side to the shaded side, and that it is neither metabolically used up nor destroyed in the light, but that correspondingly more auxin is needed in cases where the enzyme has been more strongly adsorbed—a condition which is directly proportional to light exposure.

A more complete discussion and additional presentation of data will follow elsewhere.[2]

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[2] Subsequently, it has been found that the auxin, too, is adsorbed in a manner similar to the adsorption of the enzyme.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A RAPID AND ACCURATE MICRO METHOD FOR THE ESTIMATION OF THE SULFONAMIDES

THE analysis of body fluids for the sulfonamides is a subject of clinical importance. The method of Bratton and Marshall[1] is at present most widely used, though it has several shortcomings. The method consists of precipitating the protein of the fluid with trichloracetic acid, filtering, diazotizing the aryl amine in the filtrate with nitrous acid, adding ammonium sulfamate to destroy the excess nitrous acid and coupling the diazonium salt with N-1 naphthyl ethylene diamine. The color intensity of the azo dye

[1] A. C. Bratton and E. K. Marshall, Jr., *Jour. Biol. Chem.*, 128: 537, 1939.

solution is a measure of the sulfonamide content of the fluid.

The time for a single determination is exceptionally long, and the color which is formed is stable for no longer than one hour, so that it is impossible to run a large number of samples simultaneously. The nitrogen bubbles which form after the addition of the sulfamate often lead to false readings. The recovery of sulfathiazole from blood is low, and is only about 80 to 85 per cent. when the blood is precipitated in trichloracetic acid in a volume ration of 1 : 20.

Changes in the procedure have removed all the causes for these objections. In the micro method, the blood is precipitated with trichloracetic acid containing a small amount of sulfuric acid. Then sodium nitrite in excess is added to the filtrate, and ethyl alcohol added to the solution of the diazonium salt. The coupling with N-1 naphthyl ethylene diamine is carried out in this solution. It was found unnecessary to add the ammonium sulfamate, the color being more stable in its absence.

It was shown that the blood need not be laked prior to precipitation of the protein in order to obtain complete recovery of the sulfonamides. This is pointed out in Table I, together with comparative results obtained by the Bratton and Marshall procedure.

TABLE I
FREE SULFATHIAZOLE LEVELS—(MG PER CENT.)

Subject and dose	Regular Bratton and Marshall method	Micro method: Blood pptd. directly	Micro method: Blood laked before pptn.
Rabbit— ½ g of STA orally. Blood taken after one hour.	3.0 (trip.)	3.5 (trip.)	..
Man— 2 g of STA taken orally. Blood taken after two hours.	2.9 (dupl.)	3.6 (dupl.)	..
Man— 1 g of STA taken orally. Blood taken after two hours.	2.8	3.3 (dupl.)	3.3 (dupl.)
Rabbit— ½ g of STA taken orally. Sample after one hour.	3.5 (quad.)	4.0 (dupl.)	4.0 (dupl.)
Man— 2 g of STA orally. Sample after one hour.	2.3 (quad.)	2.6 (trip.)	2.6 (quad.)
Man— 2 g STA orally. Sample after 4 hours.	2.7 (trip.)	3.1 (quad.)	3.1 (quad.)

No interference from bubbles was noticed, because the sulfamate-nitrous acid reaction was eliminated. The time for a single analysis is reduced to about eight minutes. This is to be compared with about forty minutes for the Bratton and Marshall procedure, and about twelve minutes for the Werner procedure.[2] Recovery of sulfathiazole added to whole blood was 95 to 100 per cent., at a dilution of 1 : 20, and results on blood of patients who have received the drug were about 15 per cent. higher by the micro method than by the Bratton and Marshall method. This was taken to indicate almost complete recovery of the drug. The color which was formed was stable enough to permit accurate analysis for twenty-four hours.

Substantiating experiments and a discussion of the results will be published elsewhere as soon as the method has been tested under clinical conditions.

The experimental procedure is briefly as follows: Whole blood (0.30 ml) is added dropwise with vigorous shaking to 5.70 ml of "acid mixture" which is prepared by adding 56 ml of 4 N sulfuric acid to one liter of 3.33 per cent. trichloracetic acid. The protein is allowed to coagulate and is filtered through Whatman number 1 or 42 paper. Sodium nitrite solution (0.10 per cent., 0.10 ml) is added to a 2.00 ml aliquot of the filtrate, and three minutes is allowed for diazotization. Ethyl alcohol (1.00 ml) is added, the tube swirled, and 0.10 ml of N-1 naphthyl ethylene diamine (0.10 per cent.) added. The color forms to its maximum intensity in fifteen seconds.

The determinations were carried out in flat-bottomed 10 ml vials, and the color intensities measured in micro cuvettes, using a Coleman Universal spectrophotometer. It was also noted that the values could be found with fair accuracy by visually comparing the developed colors with color standards made from a mixture of fuchsin and methyl violet.

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[2] M. C. Andrews and A. F. Strauss, *Jour. of Lab. and Clinical Medicine*, 26: 888, 1941.

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SCIENCE, SCIENTISTS AND SOCIETY[1]

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THE subject selected for this address—"Science, Scientists and Society"—is indeed formidable, at least to any group assembled for an occasion such as this. On the one hand, the range is nearly limitless; and, on the other hand, time and the ability of the speaker are definitely limited. Then, too, triteness is a handicap, for often equivalent subjects must have served many a commencement speaker needing a non-committal title for his remarks.

Nevertheless, the choice was made deliberately, since previous addresses by chemists before this academy have all been very general in nature. Formulas and equations, the chemist's indispensable form of sign-writing, have been almost entirely avoided. In following this precedent it seemed wise to reject as possible subjects various aspects of analytical chemistry, my principal field of research. In a more positive direction, the choice was made because of a feeling that what is most fundamental in science for a chemist is equally fundamental for other scientists. Whatever interest the discussion may have, therefore, should be general.

THE PROBLEM

Many years of teaching and research have aroused a personal desire to know, as far as possible, the essence of the scientific activity to which most of us are devoting our lives. Just what is science? Is it a kind of religion, sufficient in itself as a way of life in modern society? If all were trained in science, would we be able to live together happily thereafter? Possibly what I have in mind may be clearer in the form of another question—What does science mean to me? Obviously, the answer to be proposed is entirely personal. My only justification for presuming to present it is the

[1] Address presented by the retiring president of the Indiana Academy of Science at the fall meeting, October 30, 1942.

hope that each of you, if you have not already done so, will make a similar effort to answer the question yourself. Like John Dewey, most of us must feel some urge to pursue such a quest for certainty. One's answer reflects his attitude as a scientist.

These broad aspects and implications of science seem to have little interest for the average scientist and technologist. Busy with their respective activities, these people transmit tradition, pigeon-hole facts, theorize about them, and apply them in a thousand ways. Although the total effect of these activities during the last two centuries has been profound, both on our daily lives and on our thinking, only occasionally have writers tried to evaluate the really basic contributions of science and scientists to society and to focus their possibilities on the future.

Such evaluations as have been made range from high praise to disparagement. The former is represented by the predictions of A. H. Compton and of J. D. Bernal that science can remake the world, and by the assertion of W. B. Pitkin that scientists are the only ones to-day who have anything worth saying. For the latter we may mention the book, "Science the False Messiah," by C. E. Ayres, and the statement of Vice-President Henry A. Wallace that science, during the last hundred years, has merely increased the speed of life without increasing its quality.

President R. M. Hutchins, of the University of Chicago, a prominent student of educational trends, has questioned the basic contributions of science to society. Excerpts from his addresses are quoted.

> The sciences at best may help us to attain our ends if we knew what those ends were; . . . but we do not know where we are going or why, and we have almost given up the attempt to find out. We are in despair because the keys which were to open the gates of heaven have let us into a larger but more oppressive prison house. We think those keys were science and the free intelligence of men. They have failed us. Many have long since cast off God. To what end can we now appeal? The answer comes in the undiluted animalism of D. H. Lawrence, in the emotionalism of demagogues, in Hitler's scream, "We think with our blood." . . .
>
> The centrifugal forces released through the dissolution of ultimate beliefs have split the universities into a thousand fragments. These institutions, instead of leading us through the modern world, mirror its confusion. . . . We are in the midst of a great moral, intellectual and spiritual crisis. To pass it successfully or to build the world after it is over, we shall have to get clear about those ends and ideals which are the first principles of human life and of organized society. Our people should be able to look to the universities for the moral courage, the intellectual clarity, and the spiritual elevation needed to guide and uphold them in this critical hour. . . . Research is not enough either to hold the university together or to give direction to bewildered humanity. We must now seek not knowledge, but wisdom.

In re-examining science for its essence there is this year, as never before, more than satisfaction of mere curiosity to be considered. Involvement in another world war, threatening our very civilization, makes especially urgent the question of what permanent help we may expect from science. We need occasionally to transcend our specialties to gain a balanced perspective of just what science is, and is not, in contemporary life.

Most scientists would probably agree that science represents primarily an extension of knowledge. Presumably such accumulated information is expected to accrue to the benefit of mankind, for people have long been told that the truth would make them free. Thus,—in theory at least, it would seem that science should serve society in some constructive way.

By itself, and through innumerable practical applications, science has been, in fact, of untold benefit to us. We know more about the material universe, and we are better able to control it, than any preceding generation. All this is, or could be for the general good. Such information and activity are potentially constructive in helping us to meet the ceaseless succession of events constituting the cosmological drama. That knowledge is power has become a proverb of the race. The scientist and technologist appeared in the scene only recently; but so significant have been the results that we often hear the present period referred to as the age of science.

Unfortunately, science, especially in its applications, does not necessarily contribute to the general welfare. As a result, many individuals have been, and some still are, critical of our work. Lavoisier, the greatest chemist of the eighteenth century, was beheaded with the curt comment that France had no need for scientists. Recently holidays for research have been advocated, presumably in the hope of reducing technological unemployment thereby. The year 1942 finds us in the midst of the most devastating war in history, one whose unparalleled destruction is possible only because of scientific knowledge.

We are faced, then, with a great paradox of constructive versus destructive possibilities and actualities. I shall attempt to examine the relation of science and scientists to human affairs in the hope that an orientation of our perspective may aid in making dominant the constructive potentialities of science. Also we shall note what science does not, and probably can not, do. In the time available it will be possible to indicate only in broad outline what seem to be the most important aspects of this problem.

Science and Its Accomplishments

Science may be defined as knowledge which has been systematized with reference to the discovery of general truths or the operation of general laws. The

process of assembling, organizing and applying this knowledge has long been under way. For centuries the rate of progress was very slow; but in recent decades it has been so accelerated that to-day the civilized world is relatively aware of the larger subdivisions of science, such as biology, chemistry, geology and physics.

For the present purpose our interest is not in the minutiae of any of these subjects. What seem important are the items that may be considered as a kind of scientific common denominator. Long contemplation of what these are has led to the conclusion that all science, theoretical and applied, can be reduced to two categories—facts and their interpretations. It will now be necessary to examine each of these categories more at length. Subsequently, attention will be directed to the procedure of science, the scientific method, including its motivation and application.

I. *Facts*. Science begins with facts and facts form its body. These units of funded experience and knowledge are its basic truths.

A. S. Eddington refers to facts as being often primarily meter readings. Yet we must have many of them, for they are the basis of understanding and of intelligent action in the physical world. For example, the uninformed might eat cyanide, but only once, of course. Constituting the principal portion of the descriptive material in sciences such as biology, chemistry and geology, facts represent observational records. In addition, they serve as the foundation of all applied science. Through invention they yield new machines, processes, compositions of matter and biological plants.

Incidentally, in spite of their obvious importance, facts may be overemphasized in teaching. We instructors may be largely responsible for the development in certain students of a near-allergy for the sciences. These subjects, instead of being a thrilling intellectual awakening to such students, mean chiefly the memorization of endless bare facts, to be parrotted back to the instructor and then promptly forgotten. As stated by a novelist, the subject is treated as "a corpse which bit by bit we painfully dissect."

Facts should be definite and unquestionable. Also it is highly desirable to have them demonstrable in order to make later verification possible in case of doubt. Indeed, some consider that in science a fact must be mechanically demonstrable to be true.

There are, however, many conflicts over facts, for scientific observation is often subject to illusion and error. Thus most people state that the sun rises in the east and sets in the west, although it does neither. Frequently facts are difficult to obtain, and there may be disagreement as to what they are. One needs only to mention such problems as prohibition of alcoholic liquors, the economic depression of 1932 or one's chances for immortality without baptismal immersion to illustrate the confusion that may prevail. For these troublesome cases Glenn Frank advised that "all the remedies for all the types of conflicts are alike in that they begin by finding the facts rather than by starting a fight."

"The recording of facts," according to the late Justice O. W. Holmes, "is one of the tasks of science, one of the steps toward truth; but it is not the whole of science. There are one-story intellects, two-story intellects and three-story intellects with sky lights. All fact collectors, who have no aim beyond their facts, are one-story men."

Mere collections of facts do not make science, any more than a pile of stones makes a house. The facts must be systematized, according to suitable criteria, to constitute scientific knowledge. This classification process is really only an extension of the description process of fact collecting.

Chemistry presents two striking examples of classification. The compounds of carbon are arranged in the monumental treatise of Beilstein according to classes. The 4,877 types projected about the year 1900 have been found adequate for the third of a million organic compounds now known. The compounds of the other 91 chemical elements are discussed in inorganic treatises primarily according to families, as found in Mendeleef's famous periodic table. Without such organization, the countless facts covered in either case would be largely useless.

Finally, it should be noted that facts, in and of themselves, do not move us to do anything with them. For instance, how many, even among scientists, act on the basis of the known facts of genetics when they select the parent of their prospective children? Neither more facts, nor wider dissemination of those we already possess, will alone be sufficient to improve society.

II. *Interpretation of Facts*. The poet Noyes visualized the next step in his statement, "Day after day the slow sure records grow, awaiting their interpreters." Such are the multi-story men of Justice Holmes. "Two-story men," said he, "compare, reason, and generalize, using the labors of the fact collectors as well as their own. Three-story men idealize, imagine, and predict. Their best illumination comes from above, through the sky light."

Interpretation of facts consists, then, of finding relationships and formulating generalizations. The facts are the basis for conclusions, reached by induction. One may distinguish between the process followed and the products obtained.

(1) *The Process*. The first step in any interpretation is to study the facts, both individually and collectively. After they are subjected to scrutiny from all feasible viewpoints, possible or probable conclu-

sions are proposed. Finally, we formulate our tentative generalizations or plans of action.

Many would maintain that this operation consists in explaining the facts. We should note, however, that one does not explain phenomena in any final sense. Science merely locates things and their actions in space and time. It does not indicate what finally makes them act or why they are.

According to H. Poincaré, the mathematician, science can not teach us the nature of things—only their relations. Science "explains" a phenomenon, the effect, by showing that it is a necessary, or probable, consequence of another phenomenon, the cause. As R. W. Emerson said, "the effect already blooms in the cause." Over-zealous teachers, in asking for explanations of phenomena, run the risk of developing in their students an unjustified feeling of finality in this respect. At best, with Shakespeare's soothsayer, one can state, "In Nature's infinite book of secrecy a little can I read."

If we have difficulty agreeing upon the facts which bear on a given problem, it is little wonder that different people may interpret a given set of facts differently. The development of science has seen the rise and fall of many an interpretation. One of the most famous examples in chemistry was the phlogiston theory of combustion, advocated for more than a century by all the famous chemists of the time but now recognized as a totally erroneous concept.

(2) *The Products.* The results of generalization, whenever the process is carried far enough, may be recognized in one of three forms. These are so well known that they need little more than mention here.

An hypothesis is the least definite of the interpretations. It is not much more than a tentative assumption regarding possible cause-effect relations, an intelligent guess about the how of things.

A theory may be considered as a more or less matured hypothesis. It has advanced far enough toward certainty to be subject to experimental verification. It must be open to modification as long as experiments do not support the necessary conclusions. A theory is the working plan of projected experiments, such as the enterprise of the Tennessee Valley Authority.

A law is a generalized statement of the order or relation of phenomena. A law of nature explains nothing, of course, for it is only a descriptive formula which states what things do. In it isolated fact-descriptions are given a generalized description form. Even then few laws are more than approximations, for they generally rest upon statistical probability.

III. *The Scientific Method.* Our vast stock of facts, and of interpretations in the form of theories and laws, combined with myriad technological applications based upon them, represent a truly remarkable achievement of the human race. The material contributions of the last two centuries far exceed all similar prior progress. Such extensive accomplishments merit consideration of their cause.

Many factors must have been operative; but probably it would be conceded that objective experimentation and impartial thinking, more than anything else, are responsible. In fact, A. N. Whitehead has stated that "the greatest invention of the nineteenth century was the invention of the method of invention." In the words of E. C. Wickenden, "progress no longer waits on genius or the occasional lucky thought—instead we have learned to put our faith in the organized efforts of ordinary men." Our great industrial research laboratories are striking evidence of this faith.

This process, which has proved so fruitful, is known as the scientific method. Briefly, it involves collecting the facts, sorting or classifying them, formulating conclusions therefrom, and, if possible, subjecting these to experimental verification. Publication of the results usually follows with academic scientists. Perhaps the most succinct statement of the process ever made is that of Glenn Frank, a non-scientist. In his words, "our concern with the facts is to (1) find them, (2) filter them, (3) focus them and (4) face them."

In discussing progress in his book, "The Mind in the Making," J. H. Robinson outlined four principal types of thinking. (1) We day-dream—an activity to be observed among one's students, or possibly one's colleagues. (2) We make routine decisions—often a necessary activity; for example, one has to select items at a cafeteria counter. (3) We defend our prejudices —an activity in which we really begin to show some zest, especially if the subject in question is economic, political, religious, or social, and if we have been suitably conditioned in early life. How much time and energy have been wasted here. (4) We think creatively—an activity Professor Robinson ranked low in quantity. Its quality, however, is about the only hope the race has for material progress. The great performers in this category are Holmes's three-story men—the Newtons, the Darwins and the Einsteins.

With scientists this creative thinking involves the scientific method. Its effectiveness depends upon obtaining the facts without resort to authority and upon reasoning with an unprejudiced mind. The most important result of science teaching, according to scientists, would be achievement of this self-elimination in forming judgments. The significance of this attitude of mind can not be over-emphasized. Probably the basic test of a scientist is his sincerity toward the scientific method.

The extent of our factual knowledge, and of its technical applications, would seem to be ample evidence of the worth of this method. Nearly every science teacher extols its merits, and he would vigorously affirm that his first teaching objective is to inculcate his students with this process of thinking, to be used not only in the specific subject studied but also in everyday problems. To illustrate its industrial effectiveness he may point to the fact that chemical research laboratories of the United States have produced more than 200,000 products since 1914.

LIMITATIONS OF SCIENCE AND SCIENTISTS

With this record of achievement, represented by an immeasurable extension and application of knowledge, using a process of proven worth, who could be dissatisfied? Yet thoughtful individuals have expressed disappointment in the total results. Thus, according to Vice-President Wallace, himself a scientist, the last century of science has not improved the quality of society, although science yields annually an ever greater stream of truth.

The present state of society and the attitude of men toward each other, after two centuries of contact with modern science, make one wonder. Is there any basis for adverse criticism? If weakness exists, can anything be done about it? Or have we simply been misled to expect too much?

Since the scientific method has been so effective in obtaining truth about the physical world, many have assumed that knowledge of this effectiveness insures application of the process, at least by scientists and those trained in science, to focus this truth on our daily problems. If one is shown the way, it is only reasonable to assume that he will follow it. Such complacency, however, is destined for disillusionment. Once again, the process consists in finding, filtering, focusing and facing the facts. Obviously, this is merely a logical sequence of actions. What is lacking is motivation for action. There is nothing inherent in the method either to make one want to get the truth or to act upon it if and when obtained. How many chemists, for example, to say nothing of the thousands who have studied chemistry incidentally, try to live according to the best knowledge of physiological chemistry? We know well enough the way to normal weight and to sobriety; but the fat and the alcoholic continue wih us. We need, as Glenn Frank stated, a fifth step—following the facts. Even this would not provide the initial urge to get them.

H. G. Deming, a chemist, must have sensed this limitation when he wrote:

> science is but a feeble means for motivating life. It enlightens men, but fails to arouse them to deeds of self-sacrifice and devotion. . . . It dispels ignorance, but it never launched a crusade. It gives aid in the struggle with the hard surroundings of life, but it does not inform us to what end we struggle, or whether the struggle is worth while. . . . Intelligence can do little more than direct.

This lack of motivation in the scientific method, combined with the mental inertia of the ordinary habit-laden individual and the emotional inertness of facts, undoubtedly accounts largely for what we find on surveying the adoption of the process by scientists for general use and by the educated public.

Most reputable scientists are likely to conform to the method reasonably well in their specialties, particularly if the work is to be published. It is well known, however, that even eminent men may show little more than the prejudices established by early conditioning when they presume to discuss topics outside their own specialties. In fact, it is not common to find scientists who can be generally trusted for scientific soundness of judgment on non-scientific subjects. Winning a famous scientific prize or holding an important position give no assurance that the individual's opinions on economic, political, religious or social questions have any considered factual basis. This abandonment of the scientific method by many scientists, when they close the door of their laboratory, reminds one of the pseudo-religionist who goes to church on Sunday and then grabs all he can on Monday. A man's veneer of scientific attitude must be thick to prevent his thus easily reverting to the prejudices of youth.

The so-called educated public gives us even less reason for optimism. President N. M. Butler, of Columbia University, has stated the case in an annual report, from which quotation is made:

> For two generations, a very considerable part, perhaps a major part, of the effort of educational systems and institutions has been expended upon the development of teaching and research in the natural and experimental sciences. . . . The essential fact in all scientific study is the use and the comprehension of the scientific method. Every conclusion as it is reached is held subject to verification, modification or overthrow by later inquiry or by the discovery of new methods and processes of research. . . .
>
> One would suppose that after half a century of this experience and this discipline the popular mind would bear some traces of the influence of the scientific method, and that it would be guided by that method, at least in part, in reaching results and in formulating policies in social and political life. If there be any evidence of such effort, it is certainly not easy to find. Passion, prejudice, unreason still sway men precisely as if scientific method had never been heard of. How is it possible, with all the enormous advances of science and with all its literally stupendous achievements, that it has produced such negligible results on the mass temperament and the mass mind?

This is a question that may well give us pause, for something must be lacking if intelligent men and women, long brought into contact with scientific method and scientific processes, pay no attention whatever to these and show no effect of their influence, when making private or public judgments.

If we teachers are producing only partially scientific scientists, and almost entirely non-scientific laymen, what is the reason? Probably foremost is our own incomplete exemplification of the scientific attitude. We can hope to justify the method to others only as we believe in and practice it generally ourselves, irrespective of the possible personal rewards or costs. To the extent that expediency makes us disloyal to this ideal, we foster the cynical, widespread suspicion that every man has his price. It is hardly necessary, of course, to note that attempting to be scientific in everyday life and to follow one's conclusions may take courage and be costly, as more than one scientist can testify. Stuart Chase has analyzed this problem most effectively in an article entitled "The Luxury of Integrity."

Although more truly scientific teachers and leaders would help, another fundamental obstacle is our current conception of success. We are motivated, with too few exceptions, by dollars and things rather than by ideals of understanding and of humanitarian service. For measuring accomplishment the popular standard is income in industry and number of publications in college teaching. Thus despoilers of the nation's natural resources are likely to be honored as great business men, if they become rich, while the discoverer of a fundamental law of nature may go hungry. "If there is a fatal weakness in American society," writes A. H. Compton, "it is the lack of (enduring) objective." But, undaunted by this idolatry of the material, Lewis Mumford, new head of Leland Stanford's School of Humanities, still thinks the ultimate problem of a university is one of values rather than publications and patents.

Consideration of this diverse motivation, ranging from the idealistic to the materialistic, may help us to understand something of the social actions of scientists and of the technologists who use science.

Those directing their efforts toward idealistic goals are attempting first of all to understand the facts, as far as possible. Individuals with curiosity long to learn about man and his world. How does the firefly produce his light? What causes the succession of the seasons? Why do some people have red hair or in later life have left on their head little of any hue? These and a thousand like questions crowd the mind of any one alert to his physical environment. The thinking man has the capacity and likes to understand things.

To achieve the highest good, this individual attempts not only to understand the facts, but also, in the light of them, to make that adjustment to his physical environment, including his fellow men, which will promote the general welfare. To him knowledge of nature results both in admiration for its laws and in an effort to conform to them. A famous chemist, Justus Liebig, recognizing the ideality possible in this direction, stated that science to such individuals is a goddess to worship.

Although few people would object to a better understanding of facts, evidently what is most often sought of science is facts to use, whether they are understood or not. Control of their environment, by means of applied science, seems to be the goal of the majority of scientists and users of science. Thus the chemist makes synthetics, the metallurgist alloys, the physicist radioactive atoms and the geneticist new plants.

To what purpose is all the latter activity directed? Why are our research and development laboratories, numbering more than two thousand in the United States alone, spending many millions of dollars annually to get new facts and make new products? Primarily the urge is to survive or to gain personal or group advantage. The individual strives to make some discovery, usually in order to reap financial or other personal reward, rather than to improve the lot of humanity. The great corporation aims to keep in advance of competitors; real competition spurs ingenuity, discovery and invention. Something of the extent of such activity is revealed by the announcement each Tuesday of approximately a thousand new United States patents.

Liebig must have felt this materiality when he completed his statement about science by noting that to many individuals it is merely a cow to milk. Among the milkers one finds the whole collection of self-seekers, the most offensive of whom use science chiefly as a means for accomplishing their selfish objectives. Here, unfortunately, are the acquisitive, the egotistic, the expedient, the insincere, the dictatorial, the ruthless and the dishonest—in short, the little Hitlers of science. To this group may be traced most of the distrust and discord so often found among academic and industrial scientists. What a change in personal relationships, and consequently in science, would result if these people were to practice the Golden Rule.

Viewed from the standpoint of the possibility of improving society, these limitations may be summarized as (1) emotional inertness of science, (2) lack of motivation in the scientific method and (3) low social consciousness of the majority of those trained in science. As for the first two, we must resign ourselves to the inevitable—they are facts. Any hope of improvement, therefore, must center in the human

element. A. A. Berle, Assistant Secretary of State, used these words: "The techniques of modern life—our engineering, chemistry, and medicine . . . are only tools. In and of themselves they do nothing; what they achieve arises from the desires of men's minds."

THE FUTURE OF SCIENCE

What of the future? In such troubled times as these prophecy is extraordinarily uncertain, for no one can foretell the results of the social and political forces now loose. Science might become restricted to implementing the repressive tyranny of those in power. In suggesting other possibilities, we are assuming that no such fate awaits it.

With the return of reasonable sanity and stability in social and political life, it seems safe to predict that science will continue in the general direction taken during the last few decades. More facts will be discovered, technological applications, perhaps undreamed of to-day, will be found for many of them, and new theories and laws will be formulated. The scientific method will work in the future, as it has in the past, in the physical and biological sciences.

But need this be all? Some scientists, at least, do not think so. Since science has revealed so much about things, from coal tar to the stars, and since it has shown how to operate, these men think that economic, political and social problems are susceptible to such treatment. Indicative of this trend is the formation of the Committee on Science and Society of the American Association for the Advancement of Science. Recently its chairman, L. K. Frank, wrote, "if we are to have a social order directed by intelligence and guided by scientific knowledge, . . . scientists must take a more active role in focusing scientific study and in helping to direct the application of their findings." In similar vein, G. H. Boyd has stated, "the task of implanting the aim, the spirit, and the method of science in the minds and the activities of the public is one of the important tasks which science and industry must face."

Much as the social order seems to need such attention, it is not clear that the men quoted realize the limitations of science. It provides means and a method; but there is little probability, judging by the past, that science alone can ever make men more socially minded. Such motivation must originate in ways beyond the scope of this address. According to C. E. Ayres, "science is completely impotent to determine what had better happen. . . . The only attitude toward human struggles appropriate to modern science is serene indifference, the indifference of the dynamo or the mechanical calculator."

In considering what lies ahead, therefore, account must be taken of human possibilities and aspirations. The scientific method undoubtedly can be applied in areas now little touched, even though the process may be more difficult than in the physical sciences. Also there is certainly no reason why it can not be followed more consistently by all scientists outside their specialties, and by those whose education has included an introduction to science. The question is whether they want to do it, and whether they are able as individuals to surmount the type of educational conditioning which causes a scientist to react in ways illustrated by his voting a straight political ticket because his grandfather did.

In an ever-changing world man constantly confronts problems. Current examples are the physically and mentally unfit, distribution of wealth, conservation of natural resources and war. Although we could well use many specific contributions, such as a disease-resistant chestnut tree or a cure for cancer, the larger problems are more pressing. There is needed a long-time program based on collective, planned action rather than rugged individualism. The latter alternative is admirable in theory, to the extent that one practicing it may develop much latent ability; but general adherence to this principle would bring results such as unrestricted reproduction of the mentally defective, waste and destruction of natural resources and general practice of might makes right. Application of science and the scientific method, actuated by adequate social motivation, seems a much more promising approach.

Assuming that scientists of the future become motivated to do something, and that they have the opportunity, how would they attack a problem? The following steps seem obvious: (1) get the facts bearing upon it; (2) study it in the light of these facts; (3) choose the tentative solution which seems likely to work best; and (4) make tests to determine if this prospective solution does work. If it does not, modify the method or select another and try again; that is, resort to the pragmatic test of workability by following the Biblical admonition to "Prove all things and hold fast to that which is good."

Some famous scientists, advocating such practice, have expressed the belief that the presence of more of their number in, or close to, economic and political life would greatly facilitate the alleviation of our economic and social problems. In accordance with the Platonian vision of a society led by reliably informed rulers, the suggestion is to have a non-political, permanent, group of investigators to provide information for administrators on possible and desirable courses of action. Such boards, if sincere and socially motivated, could provide information and programs; but for success of the plan the administrators would still have to want, and dare, to apply the knowledge in order to achieve what E. Stanley Jones has called a welfare economy.

The London *Times*, in reporting a conference on science and world order, stated recently, "But though science shows the way, it would be presumptuous to believe that science alone can lead us to the goal. The men of science themselves have moved far since the era of uncritical optimism, when progress was regarded as automatic and science as its predestined instrument. We need no evidence to-day that science can serve evil ends as well as good. . . . This is no reproach to the instrument, but a reminder that the ultimate test of its value lies in the moral purpose directing it. The most important service rendered by the conference has been to bring to public knowledge the almost unlimited potentialities of human development and human well-being which science has to offer. Science provides the opportunity. There must be the will to use it."

CONCLUSION

What, then, does science mean to me? The answer includes elements of admiration, disillusionment and faith.

In essence, science represents an unbelievably large collection of facts and interpretations of these facts, relating to every known area of the natural world. Acquisition of this information and application of it in the arts and industry are the glory of the scientific method.

Science and the scientific method are primarily human tools. They provide information and means for action; but they do not suffice in themselves to make any one act or, in case of action, to direct it to human good. The latter ends, if we want them, necessitate transformation and direction of our motivation by other means.

The scientific approach is the most effective procedure thus far discovered for enabling us to understand, and to adjust ourselves to, the physical world. In doing this we may well turn to Glenn Frank for our motto. "Let's stop being radicals or conservatives," he said, "and be scientists. That is, let's *act* in the light of the facts in the case, rather than in the (twi)light of our prejudices or the faded labels of our class, our clique, or our clan."

OBITUARY

EDGAR ALLEN

PROFESSOR EDGAR ALLEN, chairman of the Department of Anatomy of Yale University School of Medicine, one of the best-known anatomists and an outstanding authority on the physiology of sex and reproduction, died on February 3. His contagious enthusiasm and energy and his stimulating personality will be missed not only by his associates at Yale but by many throughout the country. His capacity to appreciate the new and significant, his impatience with inactivity and his friendly yet constructive criticism were familiar to all who knew him.

Less than fifty-one years ago Professor Allen was born at Canyon City, Colo., on May 2, 1892. Shortly after his birth the Allen family moved to Providence, R. I., and it was there that, during his youth, he acquired a love of sailing and knowledge of the winds and currents of the Narragansett Bay and Long Island Sound that persisted throughout his life.

Immediately after completing his undergraduate study at Brown University in 1915 he began his graduate studies in biology. During his college and graduate years he contributed largely to his own support by working as student assistant, as a waiter or at other tasks. These experiences undoubtedly contributed, in later years, to the sympathetic understanding and actual assistance he afforded so many students when they were confronted by financial difficulties.

His graduate study was interrupted in May, 1917, when he volunteered for service in World War I as a member of the Brown Ambulance Unit. Later he transferred to a mobile unit of the Sanitary Corps, in which he served in France. By the time he returned to civilian life in February, 1919, he had been commissioned a second lieutenant.

During the summer of 1919 he was an investigator for the U. S. Bureau of Fisheries in laboratories at Woods Hole, Mass. That fall, however, although he had not completed his graduate studies, he became instructor and associate in anatomy at Washington University School of Medicine in St. Louis. During the following two years he completed the requirements for the degree of Doctor of Philosophy from Brown University. In 1923 he became professor of anatomy and chairman of the department of anatomy of the University of Missouri, and later he became, in addition, assistant dean, acting dean and, in 1930, dean of the School of Medicine. In 1933 he again returned to New England as professor of anatomy and chairman of the department of anatomy of Yale University School of Medicine.

Professor Allen's first interest in research pertained to the problem of ovigenesis. At a time when it was generally assumed that the female mammal was born with a full quota of ova he demonstrated that ova could and did arise after birth and even during sexual maturity. While undertaking these, now classical

studies, he was struck by the relation between growth and secretory phenomena in the vaginas and uteri and the development of the ovarian follicles. Further studies revealed that growth and regression of the follicles were associated with all the superficial manifestations of the estrous cycles. Not satisfied with a mere morphological correlation between the development of the follicles and growth of genital tissues Professor Allen, in collaboration with his friend in biochemistry, Dr. E. A. Doisy, successfully demonstrated an active estrus-producing substance in cell-free liquor folliculi of large follicles and in lipoid soluble extracts of the liquor. They were the first to demonstrate convincingly the existence of an active ovarian hormone in the absence of living ovarian tissues.

Shortly after the discovery of the "ovarian" follicular hormone Professor Allen became chairman of the department of anatomy at the University of Missouri. During the next several years he continued experiments on the biological activities, distribution and some chemical characteristics of the "primary ovarian hormone" in collaboration with Dr. Doisy. In addition, in spite of his increased teaching and administrative responsibilities, he undertook experiments on the action of the ovarian hormones in primates. He observed that hormonal factors modifying the accessory genital tissues during the monkeys' menstrual cycles are fundamentally comparable to those regulating the estrous cycles of the rodents. Uterine hemorrhage followed the cessation of adequate ovarian hormonal treatment or the ablation of the ovaries when performed at the proper time.

His early convictions that the ovum is "the dynamic center of the follicle" persisted throughout his life; he left two partially completed manuscripts dealing in part with such studies. This interest in ova undoubtedly prompted his collaboration with Dr. J. P. Pratt at Henry Ford Hospital in Detroit. They obtained the first living human ova from the uterine tubes of women operated upon at appropriate times during the menstrual cycle. They also undertook the first clinical experiments with the "ovarian follicular hormone."

The growth-stimulating action of estrogens on the genital tissues undoubtedly led Professor Allen to study their action on neoplastic growths and upon carcinogenesis. At Yale he fostered enthusiastically many investigations on the influence of steroid hormones upon carcinogenesis. He was especially interested in the influence of estrogens on the malignant transformation of the uterine cervix. His interest in the growth-stimulating capacity of the ovarian hormones was further indicated by the use of the mitosis-accentuating drug, colchicine, in studies on the genital tissues.

During the brief span of twenty-two years Professor Allen contributed over 140 publications of original investigations. In addition he edited and also contributed to the first edition of the book "Sex and Internal Secretions." The editorship of the second and larger edition was shared with two former associates at St. Louis, Dr. E. A. Doisy and Dr. C. H. Danforth. The number of researches he undertook personally was small compared to the many which could be attributed directly to the encouragement and enthusiasm he inspired among his students, graduate students and associates. He was more than generous in bestowing credit for the success of investigations upon his associates.

Honorary doctor of science degrees were conferred upon him by Brown University in 1935 and by Washington University in 1942. He was to receive an honorary doctor of laws from the University of Missouri this spring. In 1937 he was awarded the Legion of Honor in Paris where he was guest of the Singer-Polignac Foundation at a colloquy on the "Sexual Hormones." In 1941 he was honored by the Royal College of Physicians of London when they conferred upon him the Baly Medal for researches on the female sex hormones. At that time it was so appropriately stated that "his contributions to the subject form an essential foundation to modern knowledge of the endocrine action of the ovaries."

He was a member of the American Association of Anatomists, American Association for the Advancement of Science, American Society of Zoologists, Association for the Study of Internal Secretions, American Association for Cancer Research and other scientific organizations. He always enjoyed the meetings of these groups; here he had an opportunity to greet older friends and to meet new ones. Many young investigators will always remember the encouragement his friendly and stimulating comments imparted. During 1941–1942 he served as president of the Association for the Study of Internal Secretions and at the time of his death was president of the "Anatomists."

Professor Allen volunteered for service in the Coast Guard Auxiliary after the present war began. The "Skipper's" many sailing experiences had familiarized him with the irregular segment of Connecticut's coast line which his crew patrolled one day and night each week. When death struck he was on patrol duty with a unit of the flotilla in which he served as junior commander and operations officer.

W. U. GARDNER

RECENT DEATHS

WILLIAM MERRILL ESTEN, emeritus professor of bacteriology of the University of Connecticut, died on April 16 at the age of eighty years.

DR. LUTHER SHERMAN ROSS, from 1892 to 1934 professor of biology at Drake University, died on April 5 at the age of seventy-eight years.

DR. GRANT FLEMING, head of the department of medicine of McGill University, died on April 9 at the age of fifty-six years.

DR. F. G. PARSONS, lately professor of anatomy, University of London, and research fellow in anthropology at St. Thomas's Hospital, president of the British Anatomical Society, died on March 11.

SCIENTIFIC EVENTS

VITAL STATISTICS OF ENGLAND AND WALES

IT is reported in the *Journal* of the American Medical Association that a total of 168,638 live births in England and Wales during the September quarter was the highest in any quarter since June, 1930. In comparison with previous third quarters it was the highest since 1926 and represented a birth rate of 16.1 per thousand of population, the highest since 1930. In the quarter 86,893 boys and 81,745 girls were born, a proportion of 1,063 to 1,000, compared with an average of 1,052 to 1,000 for the ten preceding third quarters. Stillbirths numbered 5,425, or 3.1 per cent. of the total births, the lowest percentage yet recorded.

For the first time in any quarter since 1936 the total number of deaths fell below 100,000. The figure was 97,276, which represents an annual death rate of 9.3 per thousand and was lower than that of any third quarter since 1927. It compares with 9.7 for the third quarter of 1941 and an average of 10 for the same quarters of the previous five years. There were 6,766 deaths of infants under one year, a rate of 40 per thousand live births. This was five below the average of the ten preceding third quarters and was equal to the low record that was reached in 1939.

There was a decline in the number of marriages. The total for the quarter of 95,713 was 8,620 fewer than in the corresponding quarter of 1941 and 31,937 below the average for the same quarters of the previous five years. The marriage rate of 18.3 per thousand of population was lower than that of any third quarter since 1936. The explanation of the decline seems to be as follows: The outbreak of war was followed by an increase in the number of marriages, which is now reflected in the rise in the birth rate. This was partly due to the fact that in addition to their ordinary pay soldiers receive allowances for wives and children. The increase in the number of marriages was largely due to earlier ones, thus diminishing those that would take place in the ordinary course in the later years of the war.

APPOINTMENT OF A JUDICIAL COMMISSION ON BACTERIOLOGICAL NOMENCLATURE

AT the third International Congress of Microbiology held in New York City in September, 1939, a series of recommendations of the Permanent International Committee on Bacteriological Nomenclature were accepted at the plenary session of the congress. The third and fourth recommendations were:

> That the Nomenclature Committee, as at present constituted, shall continue to function under the auspices of the International Association of Microbiologists as it did under the International Society for Microbiology.
>
> That the International Committee shall select from its membership a Judicial Commission consisting of twelve members, exclusive of members *ex officio,* and shall designate a chairman from the membership of the commission. The two permanent secretaries of the International Committee on Bacteriological Nomenclature shall be members *ex officio* of the Judicial Commission. The commissioners shall serve in three classes of four commissioners each for nine years, so that one class of four commissioners shall retire at every International Congress. In case of the resignation or death of any commissioner, his place shall be filled for the unexpired term by the International Committee at its next meeting.

By prompt action at and subsequent to the congress ballots were cast in spite of war conditions by twenty-six of the sixty-two members of the Permanent Committee on Nomenclature. These ballots when examined by the undersigned joint secretaries of the committee in November, 1942, were found to have resulted in the selection of those whose names appear below. These are grouped in the three classes specified by the permanent committee, those receiving the highest number of votes being placed in the nine-year class, those receiving the next highest in the six-year class, etc. Names in the classes are arranged alphabetically:

> *Elected for nine years* (term normally expires in 1948): R. E. Buchanan, U. S. A.; A. J. Kluyver, The Netherlands; E. G. D. Murray, Canada; S. Orla Jensen, Denmark. *Elected for six years* (term normally expires in 1945): J. Howard Brown, U. S. A.; A. R. Prevot, France; J. Ramsbottom, Great Britain; Th. Thjötta, Norway. *Elected for three years* (term normally would have expired in 1942): A. Lwoff, France; R. Renaux, Belgium; A. Sordelli, Argentine; C. Stapp, Germany.

It has been decided to make this announcement in the hope that some plan for taking tentative action on questions of nomenclature can be developed by those members of the commission who can be reached under war conditions.

While no provision was made in 1939 for the contingencies that have arisen, it is felt that those elected should serve until successors are elected. Professor R. E. Buchanan has been asked to act as chairman *pro tem.* of the Judicial Commission as there is no possibility of securing an election under the rules as adopted.

R. ST. JOHN-BROOKS (London),
ROBERT S. BREED (Geneva, N. Y.),
Joint Permanent Secretaries, International Committee on Bacteriological Nomenclature

INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES

THE *Experiment Station Record* reports that, according to a recent article in *Agriculture in the Americas,* a site for the Inter-American Institute of Agricultural Sciences has been selected on the outskirts of Turrialba, a town in the interior of Costa Rica approximately midway between the national capital of San José and the principal port of Puerto Limón. The tract chosen for the main buildings and campus consists of 1,235 acres adjoining the Costa Rica Rubber Experiment Station of the U. S. Department of Agriculture. Most of the land has an elevation of about 2,000 feet, but wet lowland areas are included. The soils of the region are volcanic, temperatures average in the middle 70's, rainfall amounts to around 110 inches a year, and the humidity is high. The site is regarded as suitable for experimental cultivation of practically all tropical crops, for experimental work on livestock and dairying under tropical conditions, for the study of tropical reforestation and erosion control problems and for investigation of drainage practices. Near-by areas are well suited for the development of tropical crops not adapted to the lowlands.

The institute is to be managed by a corporation, directors of which will be the members of the Pan-American Union Governing Board, which consists of the United States Secretary of State and the diplomatic representatives in Washington of all the Latin-American republics. Projects will be recommended by a technical advisory committee composed of a member from each of the countries participating. At the outset, the organization will be financed largely by the United States, but it is expected that the other countries will join in the financing later under a convention to be signed.

The institute is conceived as a combination school of agriculture and agricultural research center, the facilities of which will be used by all the American republics. Its objectives, as generally agreed upon by agricultural leaders of the hemisphere, are to provide a place for research on tropical agriculture under favorable conditions, to furnish facilities for training scientific personnel grounded in tropical agricultural problems, to develop mutual understanding among agricultural students of the Americas, to serve as a center for cooperative research projects and to strengthen cultural relations among the American republics.

Plans for the institute contemplate utilization of research facilities offered by the governments of several Latin American republics as well as those of Costa Rica. Among the organizations whose facilities have been offered are the experiment stations of Puerta de Díaz (in Salta) and Loreto (in Misiones), Argentina, situated in the subtropical region of the country; the station located at Chulumani near La Paz and the farms of Trinidad and of Palermo in Santa Cruz, Bolivia; the Agronomical Institute in Belém, State of Pará, Brazil; the experiment station at Palmira, Colombia; the experimental fields situated in the region between the capital and Santa Ana in the large region of Tapachula, State of Chiapas, Mexico; the experiment station at Tingo María, Peru; the Agricultural Experiment Station at Santiago de las Vegas, near Habana, Cuba; and the Institute of Tropical Agriculture at Mayaguez, Puerto Rico.

As previously announced, the director of the institute is Dr. Earl N. Bressman, whose headquarters are expected to be in Washington, D. C., with a small administrative staff. José L. Colom, chief of the division of agricultural cooperation of the Pan American Union, has been appointed secretary of the organization; Rex A. Pixley, business manager of the institute, and Robert A. Nichols, agriculturist in charge of field operations.

THE STUDY OF MEDICINE AND THE CHANGING ORDER

A COMMITTEE to study medicine and the changing order has been organized by the New York Academy of Medicine. The objectives of this committee are defined as follows:

> To be informed on the nature, quality and direction of the economic and social changes that are taking place now and that are clearly forecast for the immediate future; to define in particular how these changes are likely to affect medicine in its various aspects; to determine how the best elements in the science of medicine and its services to the public may be preserved and embodied in whatever changed social order may ultimately develop.

Members of the committee include:

Drs. Malcolm Goodridge, *Chairman;* Arthur F. Chase, James Alexander Miller, Alan Gregg, George Baehr, Harry Aranow, I. Ogden Woodruff, Paul Reznikoff, Henry W. Cave, Tracy J. Putnam, Wilson G. Smillie, Jean A. Curran, Herbert B. Wilcox, Howard Craig, E. Tolstoi, E. H. Pool, Robert Pound and Iago Galdston, *Secretary.*

The committee plans to survey the changes that are currently taking place in our economic and social or-

ganization and to consider any changes which are likely to take place during the next decade.

In this survey the committee will solicit information and opinion from a wide variety of groups, including sociologists, economists, representatives of organized labor, industrialists, bankers and politicians. Every shade of political and economic thought is to be represented.

Also, in this connection, the committee will solicit the cooperation of those intimately connected with medicine in the capacities of deans of medical schools, teachers of medicine, hospital authorities, hospital clinicians, public health workers, those interested in graduate education, physicians in industrial medicine, medical social workers and workers in voluntary health organizations.

The committee will welcome suggestions from any one who might propose sources of information which would aid it in this study. It will devote itself primarily to the study of how, within the changing social order, the best qualities in medical service, in medical education and in medical research can be preserved and developed. It is expected that the study will continue until such time as sufficient evidence has been accumulated to make possible a considered report.

OFFICERS OF THE ECOLOGICAL SOCIETY OF AMERICA

OFFICERS, editors and chairmen of the Ecological Society of America have been elected for 1943 as follows:

President, Orlando Park, Northwestern University.

Vice-president, Paul B. Sears, Oberlin College.

Secretary, William A. Dreyer, University of Cincinnati.

Treasurer, Stanley A. Cain, University of Tennessee.

Member of the Executive Committee, S. Charles Kendeigh, University of Illinois.

Editors of Ecology, Thomas Park and Charles E. Olmsted, both of the University of Chicago.

Editors of Ecological Monographs, C. F. Korstian and A. S. Pearse, both of Duke University.

Representative of the National Research Council, Ira N. Gabrielson, U. S. Biological Survey.

Representative of the Union of American Biological Societies, Robert F. Griggs, George Washington University.

Chairmen of Standing Committees:

Preservation of Natural Conditions in the United States, Curtis L. Newcombe, College of William and Mary.

Preservation of Natural Conditions in Canada, J. R. Dymond, Royal Ontario Museum.

Study of Animal and Plant Communities, S. Charles Kendeigh, University of Illinois.

Applied Ecology, John M. Aikman, Iowa State College.

Nomenclature, Frank E. Eggleton, University of Michigan.

Historical Records, Charles C. Adams, State Museum, Albany, N. Y.

Quantitative Ecology, Geoffrey Beall, Dominion Entomological Laboratory, Chatham, Ont.

FELLOWSHIPS OF THE FINNEY-HOWELL RESEARCH FOUNDATION

AT the meeting of the board of directors of the Finney-Howell Research Foundation, Inc., 1211 Cathedral Street, Baltimore, Md., the following annual fellowships were awarded:

For the Third Year

Dr. Rose I. Shukoff, University of Petrograd. To work at the Glasgow Royal Cancer Hospital, Glasgow, Scotland, under Dr. P. R. Peacock.

Dr. Emilia Vicari, the Ohio State University. To work at the Jackson Memorial Laboratory for Cancer Research, Bar Harbor, Me., under Dr. C. C. Little.

For the Second Year

Borroughs Reid Hill, Tulane University. To work at Harvard University with Dr. Louis Fieser.

New

Dr. Nelicia Maier, Medical School, Paris, France. To work at Yale University Medical School with Dr. William T. Salter.

James Alexander Miller, University of Wisconsin. To work at the Medical School, University of Wisconsin.

Fellowships carrying an annual stipend of $2,000 are awarded for the period of one year, with the possibility of renewal up to three years, at the annual meeting of the board of directors, held at the beginning of March. Applications must be made on the blanks furnished by the secretary, and must be filed in the office of the foundation before January 1 of each year. Fellowships are awarded only for research into the cause or causes and the treatment of cancer.

NATIONAL RESEARCH FELLOWSHIPS IN THE NATURAL SCIENCES

THE National Research Fellowship Board in the Natural Sciences of the National Research Council has made the following fellowship appointments for the academic year 1943–1944:

Saul Gerald Cohen (Ph.D. in organic chemistry, Harvard University, 1940). Cornell University. Subject: The effects of changes in structure and experimental conditions on the mechanism of the hydrolysis of esters.

Aureal T. Cross (Ph.D. in botany, University of Cincinnati, 1943). University of Illinois. Subject: The value of plant microfossils for the stratigraphic correlation of coals, based on a study of the commercial coals of West Virginia.

William Hovanitz (Ph.D. in genetics, the California Institute of Technology, 1943). Place of study not yet determined. Subject: Genetics of physiological races in mosquitoes, with special reference to transmission of immunity.

Foil Allan Miller (Ph.D. in chemistry, the Johns Hopkins University, 1941). University of Minnesota. Subject: The vibrational spectra of molecules.

Paul Charles Rosenbloom (Ph.D. in mathematics, Stanford University, 1943). Indiana University—on a participating basis. Subject: Enumeration of metabelian groups of prime power order.

Helen Rawson Steel (Ph.D. in astronomy, Radcliffe College, 1943). University of Chicago. Subject: The astrophysical theory of absolute-magnitude criteria in stellar spectra.

Dolores Rose Terwoord (Ph.D. in chemistry, Catholic University of America, 1943). University of Chicago. Subject: Studies of the photosynthetic activity of plant extracts.

Herman A. Witkin (Ph.D. in psychology, New York University, 1939). New School for Social Research. Subject: The role of visual and postural factors in the determination of the constancy of the perceived vertical and horizontal.

SCIENTIFIC NOTES AND NEWS

DR. WALTER SAVAGE LANDIS, vice-president of the American Cyanamid Company, has been awarded the gold medal for outstanding services to the science of chemistry of the American Institute of Chemists, in recognition of "his contribution to engineering and development work largely in the field of nitrogen derivatives, and for his services to the professional side of chemistry." The presentation will be made at the banquet on May 15 at the annual meeting of the institute. Dr. Gustav Egloff, president of the institute, will present the medal. Addresses will be made by Dr. Maximilian Toch on "Landis, the Man," and Harry L. Derby, president of the American Cyanamid and Chemical Corporation, on the achievements of Dr. Landis.

PROFESSOR ELLSWORTH HUNTINGTON, of Yale University, is the recipient of the Distinguished Service Award of the National Council of Geography Teachers. The citation mentions his several widely used text-books, his many thought-provoking articles and his more than a score of scholarly volumes. He is characterized as the world's most widely known geographer, because parts of his work have deeply interested workers in several disciplines, including geography, geology, climatology, sociology, history and eugenics. Previous recipients of this award, last bestowed in 1940, include Isaiah Bowman, Mark Jefferson and J. Russell Smith, and the late W. M. Davis, R. H. Whitbeck and A. E. Parkins. Each of these seven men had been president of the Association of American Geographers.

AT the meeting of the Society of Experimental Psychologists held on April 9 at Columbia University, the Howard Crosby Warren Medal was awarded to Professor Stanley Smith Stevens, of Harvard University. The citation reads: "His analysis of psychological pitch has revealed both its quantal structure and its functional relation to stimulus-frequency."

DR. FLORENCE SEIBERT, associate professor of biochemistry at the Phipps Institute, University of Pennsylvania, was presented on April 13 with the first $2,500 achievement award of the American Association of University Women. The presentation was made by Dr. Kathryn McHale, of Washington, general director of the association, at ceremonies in the Philadelphia branch headquarters of the association. The monetary award was designed to help Dr. Seibert with her research in tuberculosis.

THE Royal Astronomical Society has awarded its Gold Medal to Dr. H. Spencer Jones, Astronomer Royal, for his determination of the solar parallax.

THE William Julius Mickle Fellowship of the University of London has been awarded to Professor E. C. Dodds, Courtauld professor of biochemistry at the Middlesex Hospital Medical School.

IT is stated in the *Times*, London, that Major Sidney H. Bingham, U. S. A., is the first American officer in the war to be elected a member of the British Institution of Mechanical Engineers.

OFFICERS of the International Association for Dental Research have been elected as follows: Philip Jay, University of Michigan, *President;* H. Trendley Dean, U. S. Public Health Service, *President-elect;* and Wallace D. Armstrong, University of Minnesota, *Vice-president.* E. H. Hatton, Northwestern University, was reelected *Secretary-treasurer.*

AFTER twenty-five years at Kansas State College, seven years as dean of the School of Agriculture and director of the Agricultural Experiment Station and eighteen years as president, Dr. F. D. Farrell has resigned and will become president emeritus on July 1.

THE retirement is announced of Sir Frederick Gowland Hopkins, for nearly thirty years professor of biochemistry at the University of Cambridge. Sir Frederick is eighty-two years of age.

THEODORE B. PARKER, chief engineer of the Tennessee Valley Authority, has been appointed head of the department of civil and sanitary engineering of the Massachusetts Institute of Technology. He succeeds Professor Charles B. Breed, who asked to be relieved of administrative duties so that he might devote full time to the professorship of civil engineering.

THE following have been promoted to associate professorships at Yale University: Werner Bergmann, chemistry; Nelson Dunford, mathematics; Clarence W. Dunham, civil engineering; Erwin B. Kelsey and George M. Murphy, chemistry; Abraham White, physiological chemistry, and Ernest C. Pollard, physics.

JAMES R. KILLIAN, JR., has been made executive vice-president of the Massachusetts Institute of Technology. Mr. Killian has been executive assistant to the president since January, 1939, and takes over his new post on July 1.

GEORGE H. MACNAB has been appointed dean of Westminster Hospital School of Medicine, London, in succession to Sir Adolphe Abrahams, who has retired.

THE British Minister of Aircraft Production has appointed Sir B. Melvill Jones, F.R.S., professor of aeronautics at the University of Cambridge, chairman of the Aeronautical Research Committee in succession to Sir Henry Tizard, who has retired after serving for ten years. Sir Melvill has been a member of the committee for some years.

DR. MORDECAI EZEKIEL, personal adviser to Charles E. Wilson, executive vice-chairman of the War Production Board, has returned to his former post as economic adviser to the Secretary of Agriculture.

DR. ALEXANDER SILVERMAN, head of the department of chemistry of the University of Pittsburgh, has been appointed consultant on glass to the Office of Production Research and Development of the War Production Board. His headquarters will be at the university.

T. G. ANDERSON, assistant professor of bacteriology at the Pennsylvania State College, has leave of absence to serve as a lieutenant in the Sanitary Corps, U. S. Army.

DR. G. H. PARKER, of Harvard University, lectured on animal chromatics before the Science Club at Amherst College on April 12.

THE Royal Canadian Institute of Toronto was addressed on March 20 by Professor Charles H. Behre, Jr., of Columbia University, who spoke on "The Mineral Resources of Europe." On March 22 he spoke before the department of geology of the University of Toronto on "Structural Control in Lead-Zinc Deposition of the 'Mississippi Valley' Type."

DR. LINUS PAULING, director of the Gates and Crellin Laboratories of Chemistry of the California Institute of Technology, delivered an address entitled "Chemical Studies of the Structures of Antibodies" at the three hundred and nineteenth meeting of the Washington Academy of Sciences, which was held on April 22 jointly with the Chemical Society of Washington.

DR. FOSTER KENNEDY, professor of neurology at the College of Physicians and Surgeons, Columbia University, will give the H. B. Shmookler Memorial Lecture at the Mount Sinai Hospital Conference Hall, Philadelphia, on May 3. He will speak on "Neuroses in Warfare."

THE second annual lecture under the Charles Fremont Dight Institute for the Promotion of Human Genetics was delivered at the University of Minnesota on April 19 by Dr. L. H. Snyder, chairman of the department of zoology of the Ohio State University. Endowed to the extent of more than $100,000 under the will of the late Dr. C. F. Dight, at one time a member of the Minneapolis school board, the foundation is a part of the department of zoology of the University of Minnesota and is under the direction of Dr. C. P. Oliver. Its purposes are promotion of interest in human genetics, accumulation of genetic statistical data from interesting families and public service through making information available to those whom it can help. Dr. Snyder's lecture was entitled "Heredity and Modern Life."

ROYAL SOCIETY lectures have been announced as follows: Bakerian Lecture, June 17, "Relaxation Methods, a Mathematics for Engineering Sciences," by Dr. R. V. Southwell, F.R.S.; Croonian Lecture, July 15, "Recent Developments in Chemotherapy with Special Reference to Tropical Medicine," by Professor Warrington Yorke, F.R.S.; October 14, Lecture to commemorate the bicentenary of Lavoisier's birth, "Antoine Laurent Lavoisier," by Sir Harold Hartley, F.R.S. The lectures will be delivered in Burlington House, London.

THE twenty-fourth annual meeting of the American Geophysical Union will be held at George Washington University, Washington, D. C., on April 23 and 24.

THE thirty-fourth annual meeting of the American Oil Chemists' Society will be held in New Orleans on May 12, 13 and 14.

THE summer meeting of the American Physical Society in the East will be held at Pennsylvania State College on June 17, 18 and 19, in conjunction with the American Association of Physics Teachers. The summer meeting in the West will be held at Stanford University, California, on July 10.

THE fourteenth annual meeting of the Eastern Psychological Association will be held at Hunter College, New York City, on April 30 and May 1. Dr. Gordon W. Allport, of Harvard University, will deliver the presidential address on the evening of April 30.

THE fifth annual summer conference of the New England Association of Chemistry Teachers will be held from August 27 to 30 at Phillips Academy,

Andover, Mass. The program is divided into two parts—(1) Strategic materials and (2) Chemistry teaching in the war effort. Under this latter topic considerable attention will be devoted to the participation of the teacher of chemistry in civilian defense activities. It is also planned to offer lecture demonstrations to run throughout the conference. While the summer conferences are held primarily for the benefit of members of the association, any one interested will be welcome. Further details will be published in the May issue of the *Journal of Chemical Education* and the completed program will appear in the July issue. Communications concerning the conference should be addressed to the secretary, Amasa F. Williston, B.M.C. Durfee High School, Fall River, Mass.

A National Wartime Conference of the professions, arts, sciences and white-collar fields will be held in the Hotel Commodore on May 8 and 9 under the sponsorship of eighteen national organizations and two hundred individuals who are leaders in these four groups. Dr. Kirtley F. Mather, professor of geology at Harvard University and president of the American Association of Scientific Workers, is chairman of the conference. Miss Olive Van Horn, industrial secretary of the National Board, Young Women's Christian Associations, is the executive secretary. The purpose of the conference, according to the sponsors, is to find ways by which fuller use can be made of the available skill and talent which still lies untapped throughout the country. The keynote address of the opening session of the conference on the afternoon of May 8 will be delivered by Professor Mather. Dr. Leonard A. Carmichael, president of Tufts College and director of the National Roster of Scientific and Specialized Personnel, will speak on the present and potential contribution of trained personnel to the war effort, and Dean Wayne Morse, public member of the National War Labor Board, will speak on economic stabilization and the problems of salaried professionals. There will be six panel discussions on May 9, dealing with health and welfare services, education, arts and letters, white-collar fields, and science and technology.

The Palo Alto Museum, California, according to *Museum News,* has made plans to open its new Science Wing to the public on Easter Sunday, April 25. At the dedication ceremony the building will be presented to the City of Palo Alto by Mrs. Don Hibner, president of the museum. Mayor Byron Blois will accept for the city. There will be a preview and reception for members and guests on April 24, when Robert C. Miller, director of the California Academy of Sciences, will be the guest speaker.

DISCUSSION

THE SCIENCE MOBILIZATION BILL

A Plan for the Maximum Wartime Utilization and Coordination of Science and Technology

In an article in Science (December 25, 1942), Professor Theodor Rosebury mentioned a bill to set up an Office of Technological Mobilization which had been Introduced in the last Congress. The objectives of this bill had been studied and approved by the New York branch of the American Association of Scientific Workers, which also suggested certain modifications in the proposed legislation. The bill has now been reintroduced in modified form as the Science Mobilization Bill, which is being sponsored in the Senate by Senator Harley M. Kilgore (S. 702) and in the House by Representative Wright Patman (H.R. 2100).

The new bill begins with an important statement of policy which stresses the importance of science and technology in aiding the war effort. "The Congress hereby recognizes that the full development and application of the nation's scientific and technical resources are necessary for the effective prosecution of the war and for peacetime progress and prosperity . . ."

It then points out five "serious impediments thereto . . ."

(1) *Lack of information:* "the unassembled and uncoordinated state of information concerning existing scientific and technical resources";

(2) *Lack of planning:* "the lack of adequate appraisal, and the unplanned and improvident training, development, and use, of scientific and technical personnel, resources and facilities in relation to the national need";

(3) "the consequent *delay and ineffectiveness* (ital. ours) in meeting the urgent scientific and technical problems of the national defense and essential civilian need";

(4) "*the trend toward monopolized control* of scientific and technical data and other resources with lack of access thereto in the public interest; and"

(5) *Lack of coordination:* "the absence of an effective Federal organization to promote, coordinate, in the national interest, scientific and technical developments."

Evidence that such "serious impediments" to the full application of science in our war effort do in fact exist has come from many sources. Not the least important of these are the hearings of the various committees of the Senate, such as the Kilgore, Truman and Gillette committees. To overcome these "serious impediments" the Science Mobilization Bill proposes

to establish an Office of Scientific and Technical Mobilization. OSTM will receive wide powers. The sum of $200,000,000 is to be appropriated for the use of the Office. It will be empowered to conduct and to finance scientific and technical work, to acquire patents and industrial processes, and to establish a system of awards for outstanding scientific and technical contributions. OSTM is to survey facilities, personnel and requirements; to formulate programs for the development and use of facilities and personnel; and to provide and promote scientific and technical training. It is to assess scientific and technical developments in relation to their impact on the national welfare; to foster international scientific cooperation; to acquire information from other countries and to exchange information and personnel with such countries; and it is to engage in other suitable forms of international collaboration relating to science and technology.

The National Roster is to be transferred with all its powers, personnel, records and funds to the OSTM and the Selective Service Act is to be amended to enable the Administrator of OSTM to certify occupational deferments for scientific and technical personnel that are needed in the war effort.

During the war and for a period not exceeding six months thereafter, the Administrator of OSTM is empowered to put into use any scientific or technical facility, license or patent which is needed for the defense of the nation or for the prosecution of the war. This provision is subject to elaborate and appropriate safeguards and to a guarantee of adequate compensation. All inventions, discoveries and patents which result from the support of the OSTM are to be vested in the Office, which may give nonexclusive licenses for their use. Suitable monetary rewards are to be given to the individuals who made or contributed to the discoveries or inventions.

The Science Mobilization Bill provides an admirable illustration of the manner in which science and its fullest utilization both for war and for peace can be "planned" or coordinated for the benefit of the community without adversely affecting the research freedom of scientists. In fact, it seems to provide a mechanism whereby there can be achieved a great liberation of science from many of its present hindrances and whereby science can undergo great expansion in its work for the benefit of the nation. The bill thoroughly deserves to be read and carefully considered by all scientists who are interested in achieving the fullest utilization of science in the present struggle and in the future activity of a fruitful peace.

Also worth careful study are the three volumes of hearings which have already been published by the sub-committee on Technological Mobilization of the Senate Military Affairs Committee. These volumes contain illuminating discussions on the confusion which exists in regard to rubber, aluminum, sponge iron and other critical problems of our war production. Testimony exposes the failure to make full use of the National Roster. The hearings also show how special interests have often hindered the full application of rational scientific and technical procedures.

The hearings also include certain criticisms of the bill as it was introduced last year. These criticisms, too, should be carefully considered. Some of them have already been taken into account in the present Science Mobilization Bill. Recently, however, there seems to have been initiated a campaign of considerable proportions which attacks the bill on the grounds that it will lead to "regimentation" of science and technology. Study of the bill itself and of the testimony presented at the Senate hearings gives no support for this campaign. The evidence shows clearly that a reorganization of our scientific and technical establishment such as is contemplated in the bill will enhance the effective utilization of our scientific resources in the war effort and will make science a more potent force in the welfare of the nation. Coordination and support of scientific and technical work by a government agency need be no more "dictatorial" than is the administration of civil aeronautics, of communications, of the Public Health Service and of the many other valuable services performed by the Federal Government. The proposed Office of Scientific and Technical Mobilization will provide a mechanism which is sorely needed at present, for receiving and developing new ideas concerning the application of research and technology to the war effort. Through the scientific representatives on the Board of OSTM and through the Administrator of the Office, scientists and technologists for the first time will be given an opportunity to take part in the decision of national policies and will have a freer hand than at present in the support and conduct of scientific and technical activities.

The demands of the war effort are bringing forth in Great Britain also a vigorous campaign in favor of better organization and planning of science. The Association of Scientific Workers recently held an important two-day conference on "The Planning of Science" which received very wide support in British scientific and technical circles. *Nature* (February 6 and 20, 1943) has published lengthy summaries and an editorial approving the aims of the conference.

The lack of coordination which is observable in the field of science and technology is also found in other fields of our war effort. These defects have been made clear through a notable series of investigations by the Tolan Committee of the House and by the Truman, Murray, Gillette, Pepper and Kilgore Committees of the Senate. A large group of Senators has therefore introduced jointly a bill (S. 607) to

set up an Office of War Mobilization. All existing war agencies, including the Office of Scientific and Technical Mobilization, are to be brought under the coordination and guidance of the Office of War Mobilization.

Widespread individual information is the basis of an intelligent democracy. Scientists, academic and applied, would have a more direct interest than most other groups of our citizens in the proposed Office of Scientific and Technical Mobilization and a very great interest in the proposed Office of War Mobilization. They would do well to obtain copies of the bills and hearings to acquaint themselves with the terms and ideas embodied in them.

K. A. C. Elliott,
Chairman, Philadelphia branch, American Association of Scientific Workers
Harry Grundfest,
National Secretary, American Association of Scientific Workers

CARIBOU AND THE MEAT SHORTAGE

Many of our people seem concerned about the shortage in meats, which have been strictly rationed since March 29. As regards our home population it is not likely that this shortage will be serious; and it may even be an advantage, for at least the sedentary section now overeats and especially of proteins. If this were not sufficiently indicated by the tubby figure and especially by the protruding paunch of the average business man in middle life, it is confirmed by the unexpected, but considerably improved health of the British people since rationing was instituted there.

However, it is essential that our armed forces and our manual working population be supplied with an adequate protein diet, and it is pertinent to draw attention to a considerable supply of meat available in Alaska.

Since the beginning of the century there have been domesticated caribou (reindeer) herds in Alaska. Ten years ago estimated to number two hundred thousand to half a million, they have been now reduced to from fifty thousand to one hundred thousand. The wild caribou herds are estimated as between one and two millions of individuals, with other millions in Canada.

All those who have been privileged to eat caribou meat in the North will, I think, agree with me that it surpasses in its palatable qualities the best beef or the best venison. Caribou meat has something of the gamy flavor of venison, but in its juiciness it is more like beef. Already for a good many years caribou steaks have been obtainable in certain restaurants in this country, but the sale has never been large, partly because of the difficulty of overcoming inertia which favors the continued use of beef, mutton and pork, but mainly because of the opposition of the United States cattle and sheep men.

As the domesticated herds are largely in northwestern Alaska near the Bering Sea, it would be possible to ship the refrigerated meat by sea to our bases in the Southwest Pacific and to our own Pacific ports.

Wm. H. Hobbs
University of Michigan

SCIENTIFIC BOOKS

ORGANIC CHEMISTRY

Organic Chemistry. By G. Albert Hill and Louise Kelley. viii + 919 pp. 6 × 9 in. Bound in dark blue cloth. Philadelphia: The Blakiston Company. 1943. $4.00.

The authors of this new text are both leading professors of organic chemistry, one at Wesleyan University and the other at Goucher College, the former with considerable experience in the teaching of the subject to men, and the latter's teaching experience having been with women students. A collaboration of this kind should be mutually stimulating and helpful.

The result is a well-balanced presentation of the subject in its manifold and diversified aspects, theoretical and practical; including the purely descriptive side of preparation, properties and applications; the theoretical considerations underlying the behavior of certain molecules and the immensely important role of organic chemistry in the maintenance and progress of our present civilization and industries.

The volume contains 46 chapters, a glossary (mainly of medical terms), an explanation of symbols and Greek letters used and a good subject index. If it is intended to serve as a reference book, as well as a text, as its authors state in their preface, its lack of citations of the original literature and of pertinent bibliographies to supplement the necessarily restricted information given in so vast a field is regrettable.

The introductory chapter discusses the nature of atoms and of atomic linkages, including types and strength of bonds, bond angles, rotation about bonds, distances between atoms and anomalous valences; molecules, dipole moments, resonance, hydrogen bridges; the mechanism of organic reactions and the primary divisions of organic compounds into aliphatic, aromatic and heterocyclic.

The succeeding chapters present the various groups of organic compounds in the usual order, beginning with the hydrocarbons, then the alcohols and ethers, halogen derivatives, aldehydes and ketones, etc.

A helpful feature is the explanation of the generally accepted International Union of Chemistry (I.U.C.) system of nomenclature. In the chapter on "Heterocyclic Compounds," attention should have been called to the ring index, a *vade mecum* which is indispensable to all students and investigators in this branch of organic chemistry.

Liberally illustrated with structural formulas and provided with tabular summaries of important series and their properties, nearly every chapter concludes with a list of test questions. Considerable attention is given throughout the book to the use of organic compounds in medicine, and the final chapter gives a compact up-to-date review of polymerization, synthetic rubbers and plastics.

The subject-matter is well classified and arranged, lucidly and logically presented, covering the subject admirably within its space limitations, so that the book should prove a very useful and interesting first-year college text and as a foundation for more advanced and more highly specialized courses.

In paper, type, printing and binding in vermin-proof and water-resisting material, the book is up to the usual high standard of all recent Blakiston publications.

MARSTON TAYLOR BOGERT

BIOLOGICAL SYMPOSIA

Sex Hormones. Edited by F. C. KOCH and PHILIP E. SMITH. 146 pp. The Jaques Cattell Press. 1942. $2.50.

THE ninth volume of "Biological Symposia" is a presentation of eight papers delivered in a symposium on "The Comparative Biology and Metabolism of the Testicular and Ovarian Hormones," presented as part of the fiftieth anniversary celebration of the University of Chicago in September, 1941. The book has two sections: I. Sex hormones—their actions and metabolism; II. Hormonal factors in the inversion of sex.

A broad and thoughtful introductory chapter by Professor Carl Moore is followed in Section I by three more meaty disquisitions by Dr. A. T. Kenyon, Professor E. A. Doisy and Professor F. C. Koch. They discuss, respectively, the metabolic influences of gonadal hormones, the metabolism of estrogens and the metabolism of androgens.

Dr. Kenyon's is an informative account in biochemical terms of the purely somatic effects of the sex hormones. It is in essence a description of the pioneering in a field that is bound to expand and develop. His data are derived chiefly from observations on human subjects and thus give point to the need for well-controlled experiments with animals.

Professor Doisy's paper is by contrast an essay in comparative biochemistry. In a balanced survey of the chemical changes undergone by estrogens in the animal body, Professor Doisy brings order to a subject hitherto confused by purely technical difficulties. The informed reader will find this chapter a welcome corollary to Doisy's previous writings in this field.

Professor Koch's lucid chapter is an admirable synthesis of biochemical theory and clinical findings. Proceeding from the studies of androgen and steroid excretion in human subjects, normal and abnormal, to the little-known but highly interesting data on the bacterial metabolism of steroids, Professor Koch develops an excellent general picture particularly of the catabolic fate of androgenic substance. His critical account of modern theories concerned with the origins of androgenic hormones is especially clear and interesting.

In the second section of the book are papers on experimental sex inversion in the plumage of birds (by Professor C. H. Danforth), in Amphibia (by Professor R. R. Humphrey), in the rat embryo (by Dr. R. R. Greene) and in the opossum (by Professor R. K. Burns, Jr.). These papers are concerned in varying degree and detail with the bipotentiality of various somatic responses to endogenous or exogenous androgen and estrogen, particularly in embryonic life. The much more surprising effects of the sex hormones upon differentiation of the embryonic gonads are carefully detailed, from the almost complete sex reversal in certain amphibia to the sterilization in mammalian embryos. The reviewer is struck by the contrast between the biochemical analysis of the first section and the morphogenetic detail of this section. In the study of sex inversion a large biochemical gap needs bridging. The dichotomy of response of gonad cortex and medulla, Mullerian and Wolffian duct, to various steroid hormones has had a real embryological demonstration. A biochemical basis for such dichotomy is woefully lacking.

These factual summary presentations illustrate in part the dramatic development of our knowledge of steroid hormone function. I doubt that Professor Doisy realized in 1929 the consequences of his chemical isolation of theelin. His few crystals initiated the deluge of steroid hormones—androgens, progestins, estrogens, cortins. Their biological activities extend from conception to senescence. Their roles in a host of physiological processes are slowly becoming clear. This book has the special merit of shaping that clarity from a large and formless literature.

GREGORY PINCUS

CLARK UNIVERSITY

VITAMINS

The Biological Action of the Vitamins. Edited by E. A. EVANS, JR.

THIS book, which takes one close to the heart of the problem, is composed of fourteen invitation papers, presented at the fiftieth anniversary celebration of the

University of Chicago in September, 1941. The titles of the papers describe adequately the subjects covered, and the names of the participants are a guarantee of the quality of the contribution. The book will be of particular interest to the serious student and to the progressive physician. A study of it shows how extremely diverse are the various factors which come in its wide range. The contributors realize fully the vastness of the subject and very wisely make no attempt to present a mass of indirectly related experimental data which would merely serve to bewilder. The references are skilfully dovetailed into a clear account. The book is full of stimulating ideas. It is readable, comprehensive and authoritative. In many ways, the present and the past are in conflict, but the references represent the cream of the literature of both. The theories discussed are based upon scientific inquiry and, for the most part, they have proved to be sound.

Each of the fourteen papers is written by an expert who usually attempts to correlate the chemistry, physiology and clinical aspects of the cellular metabolism concerned with thiamine, riboflavin, nicotinic acid, pyridoxine, pantothenic acid, biotin, choline, phosphorus and vitamin K. The delightful personal touch in some of the papers is not often found in scientific publications. Each answers a number of questions but asks many more, especially in the clinical field. In general, the history of the individual members of the vitamin B group is reviewed from the time of their discovery up to and including current investigations. This book is especially valuable for all those interested in working on problems related to the vitamins, whether they be pure scientists or clinicians. Science students interested in the subject will find that it has a great deal of material which will be of value to them.

Tom D. Spies

REPORTS

THE WORK OF THE ROCKEFELLER FOUNDATION[1]

The Year in Brief

In 1942 the appropriations of the Rockefeller Foundation amounted to $8,227,867. This is in contrast to $9,313,964 appropriated in 1941. The income of the foundation from investments during the year was $8,271,037, as compared with $8,734,992 in 1941.

The appropriations in 1942 were distributed for the most part in six major fields, roughly as follows:

Public health	$2,700,000
Medical sciences	1,434,000
Natural sciences	815,000
Social sciences	1,326,000
Humanities	982,000
Program in China	122,000

A detailed statement of the appropriations made in 1942 appears at the conclusion of this report, beginning on page 53. Of the money appropriated during the year, 67 per cent. was for work in the United States and 33 per cent. for work in other countries. The amount spent in foreign countries was larger than in any year since 1937, and represents an increase of 30 per cent. over the average of the years 1938 to 1941. This increase is due to two causes: first, the developing program of the foundation in Latin America, and second, the growing needs of the foundation's Health Commission in connection with war activities abroad.

In contrast with the size of public funds now being spent to meet the present emergency, the eight million dollars which the foundation appropriated in 1942 seems insignificant. It is estimated that eight million dollars would take care of the current war expenditures of the United States Government for approximately forty-five minutes. But in times like these, when the intellectual and cultural life of mankind has to be subordinated to a struggle for survival, even a relatively small sum may be used effectively to help build a bridge between what men have valued in the past and what they hope to maintain in the future.

Values Not Easily Regained

In this "Review," three years ago, under the heading "Night over Europe," an attempt was made to describe the disaster which the war was bringing to universities and laboratories both in England and on the Continent. The processes of disintegration had already begun. Institutions dedicated to the extension of knowledge were being geared into the war machine. The necessities of military mobilization had decimated faculties and student bodies alike. Cultural values upon which civilization is based were being thrown to the winds as the intellectual blackout spread across half the world.

To-day the long shadows of the blackout are lengthening inexorably over the United States. We are fighting for a future in which free institutions can live, but to achieve that end we are sacrificing values which, once they are lost, are not easily regained. The crisis presents us with a problem of delicate balance, how to win the war and at the same time preserve those intellectual ideals and standards, those "great things of the human spirit," without which a military victory would in the end be nothing but ashes. History shows

[1] Review of work in 1942 by Raymond B. Fosdick, president.

us that it is possible to lose a civilization even while armies and navies are triumphant.

As in Europe, so here at home, liberal education has been discarded for the duration. Our universities are now instrumentalities of total war. Technology is left as the one subject which must be taught. History, economics, literature, philosophy—the whole range of the social sciences and the humanistic studies—have been crowded out of the picture by the pressure of higher priorities. Our young men are not to be trained in liberal understanding; they must be made into soldiers. Of necessity, their education must be an education in violence. Their participation in the cultural and social heritage of civilization is adjourned. For the time being, at least, their generation may not share in the humane tradition on which alone the building of a worth-while future depends.

Not only the undergraduate work of our colleges and universities but the activities of many of our post-graduate departments, and of our research staffs and laboratories, are being forced to pay the price which war, however necessary, inevitably exacts. On all sides, fundamental research, except as it relates to the demands of war, is being curtailed or abandoned, as scientists, technicians and students are mobilized for practical types of service. Illustrations of this situation are to be found in almost every branch of knowledge, whether it is biophysics or genetics or agriculture or economics or anthropology or the fine arts. The completion of the 200-inch telescope in California has been indefinitely postponed. The cyclotrons of the country have for the most part been forced to shut down or greatly limit their programs in pure research. Graduate schools across the land are only partially occupied; faculties are becoming scattered. And this is only the beginning of the dislocation; the end is by no means in sight. In time of war the advance of knowledge for the sake of knowledge becomes a luxury which a nation fighting for its life apparently can not afford.

These comments are made in the full realization that we have a war on our hands which must be fought to a victorious finish. But in the achievement of this purpose we need to keep in perspective the requirements of the future as well as the demands of the present. The treasure of learning and the liberal tradition can not be reassembled, like automobiles in a plant, when the long convulsion is finished; nor can scientists, doctors, scholars, philosophers and artists be fabricated over night. We need to keep soberly in mind the price we are paying for victory—not in terms of dollars, nor indeed wholly in terms of human life, but in terms of values by which the worth of a civilization is ultimately measured. Our enemies kill the humane tradition wherever they can; in the realm of the mind and soul it is their chief adversary. Our concern must be that in fighting this barbarian concept we do not inflict so serious a wound upon the intellectual and spiritual life of our country that, though barbarism is conquered without, it finds a low resistance to growth within.

These observations lead to one conclusion. Our schools, our colleges and universities and all the institutions and individuals concerned with the quest for a rational life among men have a dual responsibility in these stern days. We must of necessity serve the war effort, for there is no future for what we most desire in a world dominated by fascism. But we have a responsibility equally compelling to preserve the treasures of the spirit which we hold in trust from the past for the benefit of the generations to come. There must be no broken link in the chain, no flaw in the title deeds by which what we most cherish is transferred to the future.

The Corporation of Yale University, in a recent statement, expressed in the following words its feeling of responsibility as a "custodian of our cultural heritage":

> The Corporation wishes to impress upon Yale graduates and upon the general public the danger of the impoverishment of the nation's mind and soul, should the less tangible values of our culture be allowed to shrivel while our energies are devoted to the task of winning a war to maintain them. Of what worth is freedom from want, if our minds be on a lower intellectual level; or freedom from fear if we have a less cultured life to defend; or freedom of speech if we have poorer thoughts to express; or freedom of religion if we bring a less enlightened faith to the worship of God?

This obligation is laid on the doorsteps of all our educational institutions. It is to them that we look for perspective and leadership in such an hour as this. If they can not carry their responsibility, nobody else will, for nobody else can. In their absorption in military necessities they must not allow themselves to be mere appendages of the war machine. They must not abdicate their high purpose. Unless they keep the candles lit which have largely flickered out elsewhere around the world, we may reach the dim aftermath of war, with victory behind us, but with not enough light left to make it mean anything in terms of a brighter world.

In 1881 the College of William and Mary in Virginia closed its doors for nearly seven years. The battles of the Civil War had been fought up and down the Peninsula and had left the college physically in ruins; and although it struggled to keep going during the bitter time of reconstruction, it was finally overborne by financial catastrophe. But every morning during these seven barren years President Ewell rang the chapel bell. There were no students; the faculty

had disappeared; and rain seeped through the leaky roofs of the desolate buildings. But President Ewell still rang the bell. It was an act of faith. It was a gesture of defiance. It was a symbol of determination that the intellectual and cultural tradition must be kept alive, even in a bankrupt world.

In every school, college and university of America to-day we need to hear that bell ringing.

SPECIAL ARTICLES

THE RELATIONSHIP OF VITAMIN A TO RESISTANCE TO NIPPOSTRONGYLUS MURIS

A critical study of the work of Spindler[1] revealed the fact that lack of vitamin A in the diet lowered the resistance of albino rats to a superinfection with the nematode, *Nippostrongylus muris;* but details were lacking as to the composition of the diet or the extent of the vitamin A deficiency in the experimental animals. It seemed necessary that further work should be done, by methods somewhat similar to those employed by McCoy[2] with *Trichinella spiralis,* and by Lawler[3] with *Strongyloides ratti;* these workers correlated vitamin A deficiency with susceptibility.

It is the purpose of the present paper to give the findings obtained under controlled diet, and with chemical determination of liver vitamin A, on the influence of vitamin A depletion on the resistance of the pied stock rats, McCollum strain, to primary infection and subsequent reinfections with *Nippostrongylus muris.*

In carrying out the tests referred to in this paper, the experimental and control animals were divided into groups such that sex and weight distribution were fairly uniform. The rats averaged 70 to 80 grams in initial weight. The experimental groups were fed, ad lib, two different diets deficient in vitamin A: Diet I the yeast diet and Diet II the "synthetic" diet, respectively; and the control groups were fed the same diets plus a supplement of vitamin A, such that each rat received 150 I. U. per week. The supplement was a vitamin A concentrate diluted with sesame oil, and fed in three weekly doses by medicine dropper. The composition of the two diets will be reported in detail later.

Chemical Methods: The vitamin A content of the liver was used as an index of relative depletion. The entire liver was excised, weighed and ground up with anhydrous Na_2SO_4 until a uniform powder was obtained. An aliquot portion of liver powder was extracted with 15 cc of petroleum ether in a test tube; after centrifuging, a 10 cc portion of this extract was transferred to an Evelyn photoelectric colorimeter absorption tube. The extract was evaporated to dryness in a stream of dry CO_2, with the tube immersed in a water bath at 55–60° C. The residue in the tube was taken up in 1 cc of chloroform, and the vitamin A content determined by the addition of 9 cc of Carr-Price reagent (25 gms of $SbCL_3$ in 100 cc of $CHCL_3$), with the colorimetric measurement of the blue color developed in the Evelyn photoelectric colorimeter. The blood vitamin A was determined by the method of Kimble.[4]

Parasitological Methods: Infective larvae (isolated by means of Baermann's apparatus from 9–10 day charcoal cultures of feces of infected rats) were counted by the dilution method, suspended in known volumes of water, and injected subcutaneously into the rats to be infected. At subsequent autopsy, worms found in the intestines were counted. To determine the number of larvae in the lungs, these organs were removed at autopsy and cut into small pieces, pressed between two plate-glass slides (2″ × 3″) and examined microscopically for the presence of larvae.

Results

Experiment 1. The effect of vitamin A depletion upon susceptibility to primary infection. After being on the stated diets for 56 days, the average weight of the 24 rats reached about 140 grams. On the 57th day, each of these animals was given 2,300 *N. muris* larvae, and was sacrificed 12 days later. Post-mortem determinations revealed a complete depletion of vitamin A in the livers, and low vitamin levels in the blood, of the animals receiving vitamin A-deficient diets. These animals harbored more worms in the intestines than those on the same diets supplemented with vitamin A concentrate. It will be noted further that three rats fed on Diet I-a and two rats fed on Diet II-a died on the fifth and sixth days following infection with the larvae; whereas all the control animals, though given the same number of larvae, survived (see Table 1).

Experiment 2. The effect of vitamin A depletion upon susceptibility to subsequent reinfections. Rats, the average weight of which was between 70 and 75 grams, were "hyperimmunized" by means of serial infections with 2,000 larvae each. The first infection ran its course for two weeks; 2,000 additional larvae were then administered, followed by a third infection of 2,000 larvae two weeks later. Three weeks after the last infection the animals were divided into groups, according to the diets administered.

After being on the experimental diets for 79 days, the average weight of the 22 rats reached about 180

[1] L. A. Spindler, *Jour. Parasit.,* 20: 72, 1933.

[2] O. R. McCoy, *Amer. Jour. Hyg.,* 20: 169, 1934.

[3] H. J. Lawler, *Am. Jour. Hyg.,* 34 (Sec. D): 65, 1941.

[4] M. S. Kimble, *Jour. Lab. Clin. Med.,* 24: 1055, 1939.

grams. On the 80th day, each animal was given 2,000 *N. muris* larvae and was sacrificed 12 days later. Post-mortem determinations revealed a complete depletion of vitamin A in the liver and low vitamin A levels in the blood of the animals on the vitamin A-deficient diets. More worms were found in the intestines, but fewer worms in the lungs, of these animals; in the control animals the reverse condition was seen. See Table 1.

TABLE 1

Experiment	Dietary group	Blood Vit. A μ gm. per cent.	Liver Vit. A μ gm. per liver	Worms found at autopsy: No. in intestine	Mean per cent. infection	In one lung
I.	*Diet I*					
	a. (– Vit. A)*	4.8	5.5	2013.33‡	87.53	
	b. (+ Vit. A)*	29.3	215.0	1656.50	72.01	
	Diet II					
	a. (– Vit. A)*	6.3	3.4	2201.25§	95.77	
	b. (+ Vit. A)*	21.8	271.5	1654.17	71.92	
II.	*Diet I*					
	a. (– Vit. A)†	6.3	7.8	159.40	7.97	27.00
	b. (+ Vit. A)†	27.5	205.56	12.60	0.63	72.20
	Diet II					
	a. (– Vit. A)*	5.6	8.4	204.33	10.22	23.8
	b. (+ Vit. A)*	22.7	310.98	13.83	0.69	59.5

* Represents mean values for 6 animals.
† Represents mean values for 5 animals.
‡ Represents mean values of 3 surviving animals.
§ Represents mean values of 4 surviving animals.

Experiment 3. The effect of vitamin A depletion upon the passive transfer of immunity. In order to test the influence of vitamin A deficiency upon the efficacy of plasma from "hyperimmunized" rats, each of the two groups of normal rats, the average weight of which was about 75 grams, was infected with approximately 600 larvae, and concurrently was administered an intraperitoneal dose (5 cc per 100 gms body weight) of plasma. When the animals were sacrificed 12 days later, post-mortem determinations revealed that animals that had been given plasma from "hyperimmunized" rats fed on vitamin A-deficient diets had more worms in the intestines (average 319.33 worms per rat) and fewer worms in the lungs; while reverse conditions existed in rats given plasma from "hyperimmunized" rats fed on adequate diet with supplementary vitamin A (average 168.6 worms per rat in intestines, with more worms in the lungs).

CONCLUSIONS

The above results indicate that the lack of vitamin A in the diet of the experimental animals lowers their resistance to primary infection, as well as subsequent reinfection, with *Nippostrongylus muris*. Furthermore, plasma derived from animals with low vitamin A levels affords no protection against this parasite in the way of positive transfer of immunity. In contrast, the rats fed on the same diet, plus vitamin A supplement, developed a marked resistance to infection with this nematode, such as has been described by Schwartz *et al.*;[5] in addition to protection rendered normal rats by plasma from "hyperimmunized" rats, as previously demonstrated by one of us.[6]

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STUDIES REGARDING A GLUTAMINE-LIKE SUBSTANCE IN BLOOD AND SPINAL FLUID

IN view of the recent communication of Hamilton,[1] regarding the presence of a glutamine-like substance in the blood, it may be of interest to note some studies which we have been carrying on during the past few years regarding substances in the blood and spinal fluid which split off ammonia readily on mild acid hydrolysis.[2] We have found that spinal fluid, trichloracetic acid filtrates of blood plasma and serum, and ultrafiltrates of plasma and serum contain a substance which yields ammonia under the treatment indicated. It was also found that the rate of hydrolysis of this substance under a variety of conditions of acidity and temperature was practically identical with that of glutamine which we had prepared from beet root.[3] A quantitative method based upon those findings was developed which has been used up to date in a study of a rather large amount of clinical material and also in animal experiments.

The findings in our blood studies in man and rabbit are in keeping with those of Hamilton,[1] namely, that the amount of ammonia liberated is equivalent approximately to from 5 to 10 mg of glutamine per 100 cc of plasma or serum. It has also been found that spinal fluid contains similar amounts of this substance. This together with the studies with ultrafiltrates we believe is added evidence that the findings for blood filtrates are not due to artefacts resulting from its chemical treatment. Our method also rules out the possible presence of any appreciable amount of asparagine in the material studied.

It has been found further that insulin hypoglycemia and also the administration of glucose reduces the

[5] B. Schwartz, J. E. Alicata, J. T. Lucker, *Jour. Wash. Acad. Sci.*, 21: 259, 1931.
[6] J. Y. C. Watt, Abstract of Doctor's Thesis, Cornell University Press, 1942.
[1] P. Hamilton, *Jour. Biol. Chem.*, 145: 711, 1942.
[2] M. M. Harris, Tenth Annual Report of the Director of the New York State Psychiatric Inst. and Hosp., p. 41, 1940.
[3] H. B. Vickery, G. W. Pucher, H. E. Clark, *Jour. Biol. Chem.*, 109: 39, 1935; *Biochem. Jour.*, 29: 2710, 1935.

level of this substance in the blood, the effect of the former being more marked. The sparing action on protein metabolism by these factors is of special interest in this connection.

These findings support the suggestion which we made in a previous publication,[4] namely, that the depression of the level of the amino acids in the blood during insulin hypoglycemia may be due in part to its effect upon some point in the mechanism of the enzymatic activity of glutaminase.

The administration of certain amino acids such as (dl) α-alanine increased the level of this substance in the blood. Glycine, on the other hand, produced no effect in some animals and a variable increase in others. The reason for this variability is not clear at present but may be of importance regarding the question as to whether glycine undergoes deamination. Other amino acids are being investigated.

The findings of Krebs[5] that brain, liver, kidney and retina are rich in glutaminase activity and also the work of McIlwain[6] in which he isolated glutamine from horse meat lend added support to the probability that the glutamine-like substance is glutamine.

Our studies are still in progress and some of the clinical and experimental data will soon be published.[7]

I am indebted to Roslyn T. Roth and Ruth S. Harris for their technical assistance.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PROMISING NEW SOIL AMENDMENT AND DISINFECTANT[1]

The serious crop losses suffered by growers as a result of injuries to plants by specific organisms in the soil indicate the need for a low-cost disinfectant which could be applied as an insurance measure in soils suspected of harboring such organisms. This need is particularly great where prediction of damage can not be made prior to planting or in areas where the incidence of such damage is spotty or where the economics of the crop preclude the use of expensive materials.

Preliminary results obtained by the use of a mixture of 1–3 dichloropropylene and 1–2 dichloropropane indicate that this material promises to fill this need. The material used in these experiments was obtained from the Shell Development Company at Emeryville, California, from whom it is available in two grades, one an approximately 50–50 mixture of the two compounds, and the other a crude form containing about 75 per cent. of the mixture, the balance being impurities of various kinds. It is low-priced compared with any competing product and, compared with chloropicrin, is extremely simple to handle. It is shipped in ordinary 55-gallon drums and can be handled without the use of a gas mask in the open air. In common with similar compounds, breathing of the fumes should be avoided and the precaution taken of promptly washing off with water any of the mixture which might be spilled on the hands or skin. No other commercial use for the material has thus far been found and no priorities are currently involved in its manufacture.

Tests with rapidly maturing vegetable crops grown in soil heavily infested with the root-knot nematode (*Heterodera marioni*) have shown that a very real measure of control has been obtained, not only in the plot which was covered with asphalt impregnated paper used as a mulch paper before treatment, but also in a parallel plot which received no seal of any kind either prior to or after the treatment. This is particularly important when the needs of the small grower are considered. In these tests, injections were made at intervals 1 foot apart, the amount per acre being approximately 200 pounds. Furthermore, in these tests, the crude form of the mixture was used. This crude form contains some impurities, but its manufacture involves fewer processes and it is therefore cheaper.

Experiments in pineapple fields have been conducted since the spring of 1940. In these experiments, a dosage of 150 pounds of the mixture in pure form per acre was used and injections were made through the mulch paper. The results thus far have shown that in all the locations in which the treatments were applied, definite and favorable response in growth has been obtained. The results are particularly striking in an area where a complex, including at least *Anomala* beetle larvae (*A. orientalis*), nematodes and pythiaceous fungi, has resulted in serious plant failure. In all cases, the results can be compared with those from equivalent applications of chloropicrin and, without exception, the new treatment is at least equal to that material in its benefits.

[4] M. M. Harris, J. R. Blalock and W. A. Horwitz, *Arch. Neurol. and Psychiat.*, 40: 116, 1938.

[5] H. A. Krebs, *Biochem. Jour.*, 29: 1951, 1935.

[6] H. McIlwain, P. Fildes, G. P. Gladstone, and B. C. J. G. Knight, *Biochem. Jour.*, 33: 223, 1939.

[7] M. M. Harris, *Jour. Clin. Investigation* (in press). July, 1943.

[1] Published with the approval of the acting director as Technical Paper No. 145 of the Pineapple Research Institute, University of Hawaii.

Results in pineapple fields did not make themselves evident for over a year after treatment, indicating that the soil disinfection, apart from its immediate effect in reducing populations of harmful organisms, had also affected the soil complex in such a way as to permit the plant to gradually show increasing improvement over the untreated checks. This was in direct contrast to the results with chloropicrin which, as usual, manifested themselves earlier with a dark-green growth typical of pineapple plants grown in chloropicrin-treated soil.

It is probaly true that the broad function of treatments such as these is to amend the biological complex of the soil so that the end result expressed in terms of plant health and plant yield is favorable. Biological complexes in the soil may be radically changed through the elimination of some specific organism and the suppression or stimulation of others. Such changes may be as significant for the end result as the initial effect on the specific organism, particularly if the crop in question is slow in maturing.

Much experimental work remains to be done on the effect of the treatment on specific organisms, the range of practical dosages for varying soils and weather conditions and the possibilities of treating soil around growing plants. When the pineapple plant is used as the test plant in such experiments the final results are slow to accrue, but since the material (called D–D mixture for short) has such great potential usefulness for other more rapidly maturing crops in a great many agricultural areas, it seems advisable to present the preliminary results at this time so that these potentialities can be fully explored.

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A SIMPLE BIRD HOLDER FOR USE IN AVIAN MALARIA STUDIES

WE wish to describe briefly here the canary holder which has superseded in our laboratory the one described a few years ago (SCIENCE, 88: 114, 1938). The new holder (see sketch), which has the great advantage of not injuring a bird, consists essentially of a thin brass tube of a size that a canary can be snugly fitted into, altered as indicated below.

In what is to be the hind end a notch is made about five eighth inch wide and one quarter inch deep with holes so placed in each corner that a straight wire can be passed through both of them. Just above each of these holes a slight perpendicular groove is filed on the outer surface of the tube to serve as a lock for the handle of the key which is made of half-hard brass wire.

Thin galvanized iron sheet metal is soldered across the other end and a portion bent forward to form the headrest.

The bird is inserted slowly into the holder until its head protrudes from the opening in the front end and it is then held in position by inserting the key above

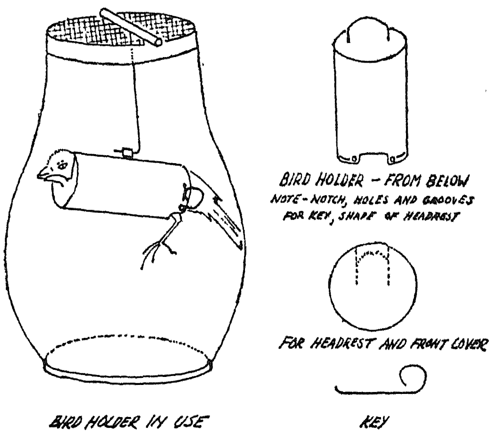

FIG. 1.

the legs dangling from the hind end and locking it in place. The holder and its contained bird are then suspended in a globe with mosquitoes.

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DULL, CHARLES E. and IRA G. NEWLIN. *Fundamentals of Machines*. Illustrated. Pp. xvi + 547. Henry Holt and Company. $2.00.

BARKER, ROGER G., JACOB S. KOUNIN and HERBERT F. WRIGHT. *Child Behavior and Development*. Illustrated. Pp. viii + 652. McGraw-Hill Book Company. $4.00.

Carnegie Institution of Washington Year Book No. 41. Pp. xxxii + 309. Carnegie Institution of Washington.

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NEEDHAM, JOSEPH. *The Teacher of Nations. Addresses and Essays in Commemoration of the Visit to England of the Great Czech Educationalist Comenius, 1641*. Pp. 99. Cambridge University Press. The Macmillan Co. $1.75.

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SOME OBSTACLES IN THE PATH TOWARDS AN OPTIMUM DIET[1]

By Dr. A. J. CARLSON

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WAR, by interference with agriculture and commerce, as well as by direct destruction of foods, brings on starvation and the hosts of human ailments that sprout on malnutrition. Hence, in a world-wide violence, like our present war, the ancient problems of individual and national diets requisite for health and efficiency become both a national and an international concern of nutrition experts, physicians, statesmen and captains of industry. These imperative problems compel the biologist to re-examine the known and the unknown in the field of food and fitness, food and life, food and victory, so that the obstacles in the path towards an optimum diet for optimum health may not trip us in the dark. Such re-examination of the nutritional history of man (and other mammals), past and present, reveal as of to-day much new and reliable information, much innocent ignorance, many faulty food habits and unwise individual and commercial food practices of to-day, unwise practices in the light of present knowledge and past experience. There appear to be even questionable building stones in our scientific edifice. Such dilemmas as the recent assertion by Surgeon General Dr. Thomas Parran, of the U. S. Public Health Service, that, in our own country with its abundance of excellent foods, and in times of peace, "one third of our people is getting food inadequate to maintain good health, and less than one fourth of the American people are getting a good diet." This is perplexing, especially in view of the more recent assertion (November, 1942) of Sir John

[1] Lecture before the Physiological Society of Detroit, Michigan, November 19, 1942.

Boyd Orr, director of Great Britain's Imperial Bureau of Nutrition: "There is no sign of malnutrition (in England and Scotland)." In fact, Sir Orr states that the people in England and Scotland are fed better in war than in peace, the people in the higher income brackets now eating one third less than before the war, and those with lower incomes are now provided with better foods. Whether or not the alarming assertion of Dr. Parran as to the American people and the optimistic statement of Sir Orr as to Great Britain will stand scientific scrutiny may be partly a matter of definitions. But, unfortunately these are not the only questionable stones in our edifice. We, the actual workers in the field of human health and nutrition, have, in most cases unwittingly, contributed many more.

The obstacles in the path towards an optimum diet are numerous. A good or an adequate diet may be defined as the kind and quantity of food which sustains the health and general efficiency of otherwise normal people at different ages. This is of course a rough overall estimate since we have no accurate quantitative measure either of health or of physical and mental efficiency. An inadequate diet obviously is the kind and quantity of food that induces physical or mental impairments measurable by our present methods. An optimum diet implies much more than this. It might be defined as that kind and quantity of food which permits and promotes optimum growth, optimum performance of all biologic functions, optimum resistance to disease, optimum conservation of the factors of safety and powers of repair and optimum length of life with optimum efficiency within the framework of the hereditary potentialities of the individual and the species. In enumerating and discussing some of the obstacles still in the way of securing or using such a diet for man, I wish to make it perfectly clear that the order of their listing does not in any way imply their relative importance. This we do not know. Colleagues working in the different fields will obviously rate these obstacles in very different order of importance, but this is of little significance since many of them overlap, and provided that we recognize them all as actual or possible factors.

(A) If the above definition of an optimum diet is accepted, it will be clear to most informed people that the sciences of physiology, nutrition and medicine do not to-day have sufficient knowledge to outline the components of an optimum diet. We do not know the optimum hereditary potentials of any one individual. We do not know the tissue reserves that any one starts out with at birth, nor do we have accurate measures of the depletion of these reserves until well advanced in the form of demonstrable or recognizable disease. We do not even know all about the optimum soil fertility for the production of grains, vegetables and fruit of optimum nutrition value. In experimental nutrition in animal husbandry the rate of growth, body size and body weight are usually taken as a measure of superiority of the diet within the framework of hereditary potentials and in the absence of recognizable disease. But one may question whether the height and other dimensions of man are adequate measures of an optimum diet so far as these elements are determined by the diet. I know of no evidence that the five foot ten inches individual is biologically, mentally and economically or even socially inferior to a six-footer. In some biological factors man is inferior to the gorilla, the tiger, the elephant and the horse. Yet he has survived and may some day conquer the jungle. The measure of biologic fitness of the man of to-morrow would seem to be the capacity to produce, serve and survive in the kind of environment worthwhile for man to live in. It seems probable that in this task the size and plasticity of the brain is of more significance than the length of the legs or the width of the shoulders. At any rate the dinosaur and the mastodon are extinct, but the ant carries on. We do not even know whether the eating of proteins considerably above the minimum requirement for growth, tissue repair and nitrogen equilibrium, is biologically indifferent, whether it improves or inspires mental and physical performance, whether it shortens or lengthens the life span. It seems clear at least to me that there is a large territory of unknown factors yet to be scientifically explored before we can talk with any degree of certainty about an optimum diet for man. Therefore those who know the most in this field ought to confine themselves for the present to such terms as a good or an adequate diet, on the positive side. If a good diet or even an optimum diet alone was omnipotent and could push back the hereditary limitations of the individual, we should not so often see differences in physical and mental capacities of children in the same family, at least not in the absence of accidents and non-dietary diseases. If a diet of "red meat" alone was the determining factor on the football field there would be no scores on either side, outside of accidents and luck. Genius, like mortals made of common clay, can neither develop their best nor for long balance on the top rung of the ladder on seriously inadequate diets. It seems equally certain that even optimum diets will not build genius out of all clays. The persistence of hereditary factors and the unknowns of mutation appear to say that much.

Drs. Park and Follis, Jr., of the Johns Hopkins Medical School, have kindly put at my disposal their results to date of their significant and long study on the prevalence of rickets in the bones of 230 children

between the ages of two and thirteen years dying of sundry acute and chronic diseases of non-dietary origin. They find signs of rickets in 46½ per cent. of these children. The acute diseases ending some of these children's lives appear to be of too short duration for the diseases themselves to have been the primary factor in the initiation of rickets although the disease might have aggravated the rickets. It is doubtful that the conditions of rickets in these children could have been diagnosed without this type of examination after death or by biopsis of the bones during life. In my judgment this is a significant approach towards the study of incipient dietary deficiencies and a commentary on society of to-day in failing to apply the known, for we have known for many years the dietary requirements for the prevention of rickets, in the absence of disease.

Our knowledge of the composition of foods, the role of foods in the living body and the specific requirements for the main groups of foods in the living organism—the proteins, fats, starches, inorganic salts and vitamins—has increased enormously in the last fifty years. This detailed knowledge has, however, not gotten down very effectively to the man in the street, the woman in the average home or the people in the factory and on the farm. More recently, the startling character of these biologic and chemical discoveries in human nutrition has, to my way of thinking, led to much unfounded anxiety, fear, wishful thinking and questionable commercial exploitation.

Whether or not we can maintain good health on 40 grams or on 100 grams of protein per day depends largely on the kind of proteins we eat, as the biologic or nutritional value of proteins differs greatly. Some ten so-called essential amino acids are now known. These protein "building stones" are so called because the human body can not make them from the other nitrogenous elements in the diet. However, these essential building stones are present in varying amounts in nearly all proteins of animal and vegetable origin. Man's past history teaches us that if we eat a sufficient variety of natural foods we will get all the essential amino acids needed for good health. Meats, milk, eggs and grains provide good food proteins. The first principle in adequate dietary proteins is accordingly: variety, natural foods, omnivorousness.

Up until yesterday even experts in nutrition thought that the nutritive significance of the animal and vegetable fats in our dietary, besides providing flavor, was: (1) energy or calories and (2) carriers of such dietary essentials as vitamins A, D and possibly others. It now seems highly probable that two or three of the numerous fatty acids in the animal and vegetable fats are as necessary in our diet as are the essential amino acids of the proteins. But, as in the case of the proteins, nutritional welfare of man lies in variety and omnivorousness, since these essential fatty acids occur widely in plant and animal fats.

(B) It is almost superfluous to point out that many diseases, acute and chronic, not primarily of dietary origin, may and do prevent, in part at least, the good effects of good diets. The infant with summer diarrhea no matter what food is given does not get the full benefit of that food. This applies to many diseases of adults. In the presence of hookworm infestation good food alone does not seem to engender maximum physical and mental efficiency. Chronic lead poisoning in the child appears to so interfere with the use of the calcium and the phosphorus in the diet as to induce or aggravate the disease of rickets. We are not now concerned with the important problem, the role of a good diet in the prevention or limitation of infectious disease. Diet alone does not seem to promise the conquest of infections. But when we speak of good or optimum diets for the entire population of the land we must keep in mind the non-dietary disease factors that nullify in whole or in part the good results expected from such diets in individuals having these diseases.

(C) *Food habits.* The food habits of man tend to become as fixed and in many cases as unreasonable as many of his religious, political and social habits. The name of foods, the visual appearance of foods as well as the taste of foods are frequently determining factors. The types of foods consumed by people or races less sophisticated, more ignorant or poorer financially than we are are frequently looked upon by us as degrading, as not good for us. Many people refuse the meat of eels because this fish looks like a snake. Many people think that food good for dogs, cats and hogs are by that token not good for man. A central factor here is obviously social habits as well as the fact that we can train our palate to like or prefer even foods markedly deficient in some of the dietary essentials. For example, the liking for sugar, sweet drinks, candy. Now sugar is a good energy food and such preference for sweets is not serious provided we eat enough of more complete foods. But when foods like pure sugar or pure starch become a larger percentage of our daily diet trouble will follow.

Wherever we turn in the dietary field, past and present, there appears an important factor of safety in omnivorousness. Very few of the natural foods contained chemical or organic poisons for man. Civilized man could be even more omnivorous than he is at present, but we do add serious chemical poisons (lead, arsenic, fluorine) to some of our very important if not necessary food categories, fruits and vegetables. To be sure these insecticides are sprayed on important human foods, not with the intention of in-

juring man but for the purpose of rescuing good human food from insects. However, one of the dietary unknowns to-day is how much of these protoplasmic poisons we can take with our fruits and vegetables during a lifetime without impairing our reserves, impairing our health. The consumer demands a perfect apple. He can see the "worm" or the track of the "worm" in the apple. The lead, arsenic and fluorine on the perfect apple he either can not see or, when he does see them, he thinks it is mere dust from the good earth. We should like to know whether the dietary health of our forbears was worse off with a worm in the apple than is ours with protoplasmic poisons on the apple.

Modifying human food habits in the direction of better health and efficiency may come through necessity or dictation. It will probably not stay put except through understanding via the long and strenuous road of education. In the matter of education in health to the extent that our health depends on food I think there is much yet to be done in our grade schools, high schools and colleges. In a not too distant past the teaching of health in our schools did not significantly transcend the tooth brush, alcoholism, sex and social diseases. Even to-day in many of our schools we find inadequate teaching of the fundamentals of health and nutrition. As if the matter of foods was a concern for women students alone and the matter of general health a concern only of the physicians. We have scarcely begun to realize that the modern sciences of chemistry and physics are so rapidly changing our environment and mode of life that proceeding to-day by the ignorance of our forbears we may travel into tragedy. Urbanization and industrialization renders it well-nigh impossible for modern man to have access to the natural unprocessed foods available to our forebears of a thousand years ago.

(D) *Food advertising.* In connection with this discussion of education of the public in health and foods one necessarily thinks of the positive and valuable role that modern commercial food advertising could play in this program. Unfortunately, such commercial food advertising in the past has frequently been misleading and occasionally undiluted artistic lying. People are urged to eat more of everything. If they did they certainly would develop dangerous obesity. The 1942 advertising of a vitamin alleged to prevent or recolor gray hair on the human scalp is as yet without foundation in science. There are cheerful signs that the more responsible food producers and food processors are now aware of their public responsibility in this field, their responsibility of contributing to factual adult education as to food and nutrition in advertising their special ware. But it is discouraging, to say the least, to have our federal government leaders urge us (in posters, advertisements and circulars): "Eat Nutritional Foods." This is silly, and, if certain foods are listed to the exclusion of others, misleading. For an article which is not nutritional is not a food.

(E) *Food refining and food processing impairing the value of foods.* The polishing of rice, the milling of the germ and much of the protein, vitamins and inorganic salts out of such foods as wheat and other grains, corn, etc., are food practices of the gravest concern to health. Purification and hydrogenation of animal and vegetable fats may take considerable if not all of the fat-soluble vitamins out of these fats. Modern preservation of food such as canning, freezing or dehydration is necessary in modern urbanization. Some food values are diminished, unavoidably, by these processes. Cooking, freezing and packing undoubtedly saves man from infectious disease, but some food values are lost. It is a question of balance of benefits. Fortunately we do still eat raw fruits and some raw vegetables. The latter could and should be greatly extended.

Digestible carbohydrates occur usually in abundance in most of our natural foods. Except by heat to point of carbonization, these food factors are not denatured or destroyed by food processing, baking or cooking, except that the sugars and water-soluble starches may be lost into the cooking and canning liquids. Dextrose, the sugar of the blood, is a necessary constituent for our internal environment. A large part of our heat and energy requirement can and should come from the starches. The starches are our most easily digested and on the whole the least expensive energy foods. So necessary is our blood sugar (dextrose) that, as in prolonged fasting, the body appears to manufacture it from body proteins, and possibly from the body fats. It now seems clear that our body can do the same with the proteins and the fats of our common foods. Hence no specific or distinct dietary deficiency disease of man is known as due to too little starch in the diet. A form of malnutrition, obesity, may be caused by eating too much starch, or sugars, as the carbohydrate in excess of our energy needs is readily converted to and stored as body fat. However, some of the important dietary deficiency diseases have come about, not by eating too much starch, but eating too little of the other important elements in the natural grains. I refer to the polishing of rice and the modern milling of wheat and other cereals for white or patent flour. The germ and the outer coats of the grain hold valuable proteins, vitamins and minerals. Human dietary safety on this front would seem to be: Go back to first principles—putting the whole grain into the flour and the bread. This can be

done. We can learn to like it. If Great Britain (at war) can take an important step in that direction, why can't we?

I believe we could learn to prevent the oxidative rancidity of whole grain flour. If we insist on milling the grain and storing the flour, instead of storing the grain, and milling as needed, there are now known relatively non-toxic antioxidants that might prevent the rancidity of whole grain flour that takes place on long storage. And until we have that problem licked, what is the matter with storing the wheat and milling the flour as we need it? I do not see any essential economic principle in storing the flour in place of storing the wheat. In my judgment, the recent addition of a little of the vitamins and minerals now milled out of the grain, and singing paeans of dietary salvation over this "enriched" flour and bread is not a sound policy either for to-day or to-morrow. Let us go back to first dietary principles on this front. The whole wheat, rye, corn or rice grain is one of our most valuable and our least expensive protective foods. Fortunately, we still eat oatmeal, a whole grain food, having, among other important nutrients, proteins of a high biologic value. On the whole we can trust nature further than the chemist and his synthetic vitamins. Recently Professor J. C. Drummond, the scientific adviser to the British Ministry of Food, voiced his reluctance to put the dietary safety of a nation on synthetic vitamins, as a long-range policy. He thinks we must, and should, provide the natural vitamins in the natural foods. I stand on that platform, until we know a great deal more than we do to-day about foods and human nutrition.

It appears true that for our forbears, except for the element iodine in restricted areas of the earth, the dietary need of minerals was efficiently met by the common non-purified, non-processed natural foods. So far as I know, this would still hold true, except for the cooking of such foods as meats, fruits and vegetables, and the habit of discarding the cooking water. To be sure the otherwise excellent natural food, milk, is so deficient in iron that an exclusive diet of milk for weeks or months brings on an anemia due to the iron deficiency in the diet. How does the American dietary stand as to some of the essential mineral needs such as calcium, phosphorus, iron and iodine? The iodine deficiency in the states whose soil and water were depleted of iodine by the waters from ancient glaciers is now taken care of by putting the iodine back into our table salt. The iodine was there before our ingenious chemists learned to take it out. Professor C. H. Sherman, of Columbia University, has long held the view that the American diet is probably too low in calcium, and possibly in phosphorus, for optimum nutrition. This problem is complicated by the fact that a modicum of vitamin D is involved in the adequate absorption and utilization of calcium and phosphorus, particularly in the growth and maintenance of our bones. I wonder if the possibility of a dietary danger in this field could not be met, universally and without cost, by adding a little calcium, phosphorus and iron to our table salt. This should offer no insurmountable difficulties, and there is no evidence that a slight excess above actual needs of these minerals works any injury to our health.

We are urged to eat milk especially for its calcium. Yes, milk is a good source for lime. But milk is a relatively expensive food, and even in our country, with a plethora of foods, there is not enough milk to go around, at least as long as we insist on butter and cream for our table, and turn so much (50 billion pounds a year) of the valuable skim milk into channels other than human food.

How much of vitamins do we need for optimum health? That the disease scurvy, induced by long subsistence on dried, cured and cooked foods, can be cured or prevented by eating some fresh or raw fruits, vegetables, potatoes, leaves or grasses has been known for more than a hundred years, but the specific chemical substance involved (ascorbic acid or vitamin C) is of very recent acquaintance, and the precise role of this vitamin in our cellular health is still partly unknown. Pellagra, beriberi and rickets are old human ailments, but their precise etiology and partial conquest belong to the last fifty years.

The recent advances in our knowledge of the chemical nature and the biologic role of the vitamins have been so rapid and so startling that, as usual, man's wishful thinking hopes to find in them the cure for nearly all the physical and mental ills to which the flesh is heir. In fact, the miracles now claimed by some misguided people for vitamin pills, natural and synthetic, rival the miracles of Lourdes. The giving a mixture of table salt, vitamin C and vitamin B_1 to workers in very hot environments, observing reduction in fatigue and heat prostrations, and concluding that the vitamins contribute to this desirable result is not a scientific experiment. For we know that under such conditions NaCl alone produces these results, and it is difficult to measure fatigue with accuracy. Vitamin concentrates are useful aids in the hands of a physician. The tragedy and waste in the 1942 vitamin pill business is this: Most of the people who can afford to buy them probably do not need them; most of the people who may need them probably can not afford to buy them. But a competent chemist asserts that "intelligence and morality go together. . . . Since an ample supply of vitamins can foster a high intelligence, it has also the capability of fostering morality!" If this be true, and if we further admit that

lying and injustice are phases of immorality, the vitamin deficiency in the human race of our generation is indeed appalling! When we have the vitamins that prevent dishonesty and injustice, the millennium will have come. But as I read and listen to the 1942 propaganda for vitamin pills, I am led to suspect that at least some vitamin vendors do not take their own medicines. They just sell them. And the selling noise is so loud that our attention is distracted from the more important role of adequate proteins in preventing one of the fundamentals in the overall malnutrition created by such catastrophes as crop failure and war.

(F) *Waste of food.* Waste of food in the family increases the cost of food to the family. It also contributes to food scarcity. Food waste in our country is partly avoidable such as the waste in the home, waste or neglect of fruit and vegetable on the farm; partly perhaps unavoidable such as that produced by oxidative rancidity of fats in the foods. I have already referred to the huge waste of skimmed milk, so far as this is turned into channels other than human food. The waste of food in the home tends to increase with the economic prosperity of the family. It is not "refined" to clean the plate. It is a measure of prosperity and caste to waste food. When we are told that under conditions of war and food rationing in England and Scotland the economically more fortunate eat one third less food than they did in times of peace, this probably means that they eat just as much food in war as in peace, if they can get it, but in war they waste one third less food at the table. When nations are facing universal food shortage, the wastage of food in the home or on the road from the farm to the home may seriously contribute to national malnutrition. Much of this food waste is even to-day preventable, but we are up against individual and social habits and agricultural practices that will yield only to education or dire necessity. Some food wastage in the home as well as in the food-processing industry appears to be based in part on the erroneous assumption that the least roughage in the food we eat the better for our health. So we peel and prune fruits and carrots, cabbage and potatoes and with such peelings and prunings we decrease or eliminate valuable food elements. The facts are the normal human alimentary tract must have some indigestible roughage to work at its optimum, and it will probably take millions of years before man has evolved, like that of the honey-bee, an alimentary tract which can function on nectar and pollen alone. It is difficult to assess the blame for some of the waste of our food, particularly the fats of animal origin. We seem to have developed the idea that the fattest hog and the fattest steer is the best hog and the best steer. These animals may be best in the sense of providing greater income to the farmer, but a great deal of the fat of the steer and even some of the fat of the hog does not reach the human stomach. From the kitchen or the dining table it passes into the garbage can or down the drain pipe.

(To be concluded)

RESEARCH IN WARTIME

By Professor J. H. SIMONS

PENNSYLVANIA STATE COLLEGE

AT a time when the nation is engaged in a gigantic war that will determine the very survival of civilization, it is appropriate to examine all our activities in the light of values in the war effort. The only purpose of any real significance for any one's actions is the defeat and destruction of the ememy. All personal or political motives represent various forms of treason. Every activity not contributing to the war effort should be either stopped or redirected. Scientific research should be examined with this point of view.

Modern war requires modern weapons, and these are directly the product of scientific research. It is true that it is a long way from the birth of ideas in the brains of the scientists, their demonstration, verification and study in the research laboratories to the final perfection of powerful weapons for the destruction of the enemy or of materials and tools for the aid and comfort of ourselves and friends. This way, however, follows a direct path that is fully recognized. From the source of the original ideas it progresses through development, engineering, trial and production. All the weapons, tools and materials of vital importance in the war, to a very considerable extent, have had their beginnings in the scientific research laboratories. The research of the past produced our present practices and materials. New things for the future will have their beginnings in the research being done at present. The only sure way of not having new weapons or major improvements of old ones is to stop scientific research.

Research is a word that is used for different meanings by different people. In some industrial firms it is made to include the development of industrial processes after the original ideas are all well founded. In other places it is used to include data collecting or the

operation of well-known and recognized techniques on a small scale in a laboratory. These activities coming under the name research are easily evaluated in relation to the war effort. A process or machine should be developed if it contributes directly to the war effort. Data should be collected if there is a wartime need for it, but otherwise not. In the same way small-scale laboratory operation of known techniques should be continued or not in relation to the use or non-use of the product for the war effort.

The more subtle meaning of the word research—the birth, demonstration, verification and study of new ideas—is a much more difficult thing to evaluate. This type of work is chiefly done in college and university laboratories. To the layman it appears to be only an academic exercise as it is not clearly defined, is not represented at that time by human use on a large scale, and most frequently is clothed in a formidable garment of technical terms. Neither industrial nor government funds are available for it, as the results to be achieved can not be written out in advance. All industrial firms and government agencies require well-formulated objectives for a project as well as a detailed outline of methods of procedure. For fundamental and original research as defined above, these are completely impossible. The real cost of this kind of work comes chiefly out of the hides of those whose artistic or fanatical urge causes them to do it. It comes in the long days (and nights), the Sundays, holidays and vacations spent on the work, frequently without much encouragement or material aids. After the fundamental work is well on its way and the new ideas have been amply demonstrated, government agencies or industrial firms will carry out the development work. The history of science gives numerous examples of the above. The early work in electricity, in organic chemistry and in physical chemistry can be cited, for these, despite their present large-scale industrial use, began in the academic scientific laboratories.

This kind of work has in the past produced results that have changed the entire course of history. Examples of this are the discovery of electromagnetism, the vacuum tube and the synthesis of ammonia and of indigo. On the other hand, the work of any one particular man may not result in such world-startling discoveries, it may only add a small but valuable amount to the sum of human knowledge. It is impossible to predict the value of the fundamental research of any one man. We do know that in general it is this work that is the fountain head of new developments. How soon or how long any particular piece of original and fundamental research will produce results that can be directly or indirectly of military value can not be stated. The undisputed fact is that the more of this kind of work in progress the greater chance there is of new weapons.

The national cost of fundamental research in men and materials is relatively insignificant. There are only a relatively small number of scientists engaged in this work (a few hundred) and their requirements in the way of equipment and help, when considered on a national scale are relatively insignificant. However, at the present time it is not sufficient to take a point of view that we can "let" them work. Letting at this time must be a positive and not a negative action. It must mean that such scientists and their students be not required for other duties such as military service or civilian defense. Their income must continue. They must have help and funds for securing materials. They must be provided with assistance and technical aids. In other words, funds, priorities and draft deferments have to be considered as part of the word "let." The assignment of priorities for research materials shows that this is recognized by the government. It is of course also important that the institutions in which this work is in progress should not consider it as an unessential academic exercise or an extra burden on the overhead account.

At the time, several years ago, when our government first recognized that our entry into the war was unavoidable, it was natural to take the point of view (and this was done by some of our military people) that the research that would be used or needed in this war was all done and that the war would be fought with what we had. They thought the same about steel capacity and the designs of tanks and planes. As the military leaders can not predict the length of the war, the time available for research to aid in it is also unpredictable. If the war is short, there is no need of disturbing or changing the present fundamental research program. If it be long, then there is a vital need for both continuing it and augmenting it in the near future. No one can tell from what laboratory will come new and important discoveries. We are certain, however, that the more fundamental and original research done the greater the chance of the discoveries. The one way not to have the discoveries would be to close the laboratories. We may be in vital need of new discoveries. Without them we shall be placed in the position of giving the enemy the initiative and following his discoveries with a time disadvantage.

Scientific advancements made during the war may be very important. The development of the synthesis of ammonia in Germany in World War One caused the blockade to be much less effective than the military

leaders of the Allies figured, because Germany was then not dependent upon Chile saltpeter for its explosives. It is the new discoveries made now or in the near future that may shape the course of victory.

To be unduly critical of any one particular fundamental research project as impractical or of only "theoretical" interest and therefore not significant for the war effort at this time is highly unsound reasoning. How can any one tell in advance to what extent or how soon it can be put into practice. What is highly theoretical to-day is put into large-scale practice to-morrow.

One can not determine the value of research to the war effort by whether or not it is fostered or financed by a government agency. Government agencies support and develop discoveries once they are made, and they also direct this development toward ends of military value. New ideas and discoveries, however, are most likely to spring up in laboratories devoted to original research, and it is these new discoveries that can then be taken by the government agencies for development. In fact, those discoveries made in the recent past in chemistry that are having the most significance at present in the war effort were not made in government sponsored laboratories. Some of these in their beginning stages would not have been financially aided by any government agency or industrial firm, as they differed greatly from commonly accepted practice. In its inability to know just which laboratory, working on original work, will produce the most vital results for the war, science is not much different from the military. The high command can not tell in advance just where the most important battles will take place. Many garrisons and bases will be unused. Many divisions and material will not see action. We can not in advance, however, say that these divisions are unnecessary.

Fundamental and original scientific research is, therefore, not only of great value for the war effort, but its continuance may be vital for victory. It is not an activity of secondary value for such things as morale or the selling of bonds, regardless of the values of these activities. Its products may have a direct bearing on killing the enemy and certainly will have, if the war lasts for years. How to continue it under present difficulties and restrictions is a matter for serious consideration. In this connection the following suggestions are made:

(1) Scientists of recognized tendencies toward original work and of proven accomplishments in fundamental research should be encouraged to continue. They should not be taken for what may be more emotionally satisfactory, work on a development project under a government contract.

(2) Priorities and draft deferments should be provided.

(3) Funds will be needed; but these should be free from the requirements of extensive reports and outlines of procedures in advance, such as are now required in most government and industrial work.

(4) The work should not be "directed" by some "committee chairman." Committee chairmen can not be familiar with the work—otherwise they would be doing it.

(5) The funds should not be dependent upon the individual scientist's political connections or his ability to get elected or appointed to committees or society offices.

(6) Students should be permitted and encouraged to enter fundamental scientific work. A great deal of this kind of work has been done in the past by students under the direction of a professor interested in fundamental research. At the present time there is danger of encouraging students to enter the so-called more "practical" lines of work. General Hershey in his statement regarding the deferment of graduate students considers only those assisting in instruction and those working on a sponsored "war project" as eligible for deferment. Research on fundamental and original scientific problems should be placed in the same category as the work sponsored by government agencies as its chance of direct value in the war is at least as great.

(7) In order to insure that the scientist engaged on original and fundamental research can direct his thoughts along lines such that his creative ideas will have the best chance of being of immediate military value, he should be made familiar with the problems, materials and techniques of military importance that are related to his branch of science. This can be done without confining him to work on any particular project and without danger of loss of confidential and secret subject-matter. The scientists of this country realize full well that our defeat will mean that they, each and every one, will be executed shortly thereafter. They have the knowledge of what has happened to their colleagues in the occupied countries of Europe. They are very anxious to help so that this will not happen here.

The day that fundamental and original scientific research stopped in Germany was the day that Germany began losing the war. This will be true provided that we do not stop our fundamental scientific research. We are in great danger of doing this at this time with our scientists being taken for development projects and other activities. If the war is a long one, we will greatly regret the loss of the scientist and his students doing original work.

OBITUARY

EDMUND SMITH CONKLIN

1884–1942[1]

All of us who were intimately associated with Dr. Edmund S. Conklin in his last years of life were deeply impressed with the calm manner in which he carried on while facing the constant threat of impending death. To the admonitions of doctors and colleagues that he give up all work and rest, he answered that when the fatal stroke came he wanted to be at his usual occupation. And so it was, that, although in his last months he was not able to do much, the end came the morning after he had spoken to a religious gathering on some psychological aspects of religion. Up to the last he was hoping to be present at the New York meeting of the Psychological Section of the American Association for the Advancement of Science. To him it seemed an opportunity lost when he could not be present to meet and chat with his many professional and personal friends.

It was characteristic of Dr. Conklin eagerly to seek and cultivate social relations. He was never as happy as when he could converse intimately with his friends concerning human problems. Indeed, it was probably this trait that directed him into psychology. Quite clear he made it to his friends that psychology was to him primarily a concern with persons and everyday activities of people. This is further manifest in his lectures and writings. In recent years he deplored certain psychological trends toward abstractness and severe formulation. He contrasted this tendency with the situation in which he grew up at Clark University when G. Stanley Hall was the dominant figure there.

A graduate of Springfield College and Clark University, he helped to give Oregon a reputation for being in some ways more like New England than New England itself. His lively interest in students is shown by his request that the student members of his fraternity, Phi Gamma Delta, call him "Ned," and the fact that his lectures in general psychology were considered outstanding by students. At the same time that he attracted such informal interest of undergraduates he always remained Dr. Conklin to his colleagues and graduate students, not through any lack of friendliness, but simply as a mark of professional respect to a scholarly gentleman.

Having gathered together a staff with whom he built the splendid Oregon psychological laboratory, together they attracted a small and highly selected group of major students whose subsequent professional development was always a matter of great pleasure of the Oregon group, particularly in their gatherings at annual meetings.

His viewpoint on the administrative functions of a department chairman may be illustrated by an early incident. When one of the writers came to Oregon from an N. R. C. post-doctorate fellowship, he called him into his office, told him what regular funds were available for his work, mentioned that he had also built up a special fund to enable the new laboratory man to provide equipment in line with his special interests, and then after showing him around the fine new laboratory gave him his only "sailing orders" in six years, by telling him to develop the laboratory courses as he saw fit, and to come to him if he could be of assistance. For him, administration was a matter of selecting personnel, and then giving them full opportunity to develop their plans, and unusually liberal and successful policy.

In 1934, when he was in middle life, Dr. Conklin was called to assume the chairmanship of the department of psychology in Indiana University. His eight years of service there were years of tranquility and orderly development for the department. His ideal was to provide the greatest possible academic liberty and freedom from annoyance for his colleagues and to encourage them in scientific productivity. As an administrator, Dr. Conklin was especially earnest in conceiving himself as "chairman" rather than "head" of a department. Matters of policy were placed before a staff conference; the decision was theirs, and a favorite project would be abandoned rather than pursued against the wishes of others. It was through their own merit that his careful plans were adopted and guided the department. The impress of his work at Indiana will be felt and remembered for years to come.

To the general public Dr. Conklin will probably be best known for his books in the fields of abnormal, genetic and religious psychology, all based on very extensive library research. Doubtless, he, himself, would have considered his greatest accomplishment to be whatever professional and personal assistance and direction he was able to give his colleagues and students in their careers as psychologists. To his earlier associates and students, now scattered among many of the larger departments of the country, psychology as Dr. Conklin conceived it to be remains a high standard by which to measure one's own professional development.

[1] This memorial statement was prepared by three of Dr. Conklin's former colleagues at the request of the executive committee of the Section of Psychology of the American Association for the Advancement of Science. Dr. Conklin was the retiring vice-president of the association and chairman of the Section of Psychology, and it was planned to read the memorial statement in place of his vice-presidential address at a joint session of the Sections of Psychology and Education at the New York meeting. Owing to war conditions, this meeting was not held.

In addition to his teaching and administrative duties, Dr. Conklin generously devoted considerable time to public lecturing. He was especially fond of presenting to psychological audiences the life and manners of his teacher Hall. In other than psychological groups he probably was most devoted to the discussion of religious topics, especially the comparison of the various forms of worship.

The essentially human interests of Dr. Conklin were revealed in his general literary reading. Samuel Johnson, the man, appealed to him inordinately. Upon occasion Dr. Conklin could spend an entire evening recounting various interesting items concerning Johnson, and evaluating the literature centering around this interesting figure. In him he found a subject which afforded scope for the expression of his own great fund of humor.

ROBERT H. SEASHORE
R. C. DAVIS
J. R. KANTOR

RECENT DEATHS

DR. WILLIAM HENRY METZLER, formerly professor of mathematics and dean of the Graduate School of Syracuse University, later dean of the State Teachers College at Albany, N. Y., died on April 19. He was seventy-nine years old.

DR. RICHARD A. VON MUTTKOWSKI, since 1925 head of the department of biology of the University of Detroit, died on April 15 at the age of fifty-six years.

THE death at the age of sixty-seven years is announced of Dr. Frederick Barry, professor of the history of science at Columbia University.

CHARLES C. WILLOUGHBY, since 1928 director-emeritus of the Peabody Museum of Harvard University, died on April 21 at the age of eighty-five years.

DR. JOHN EDWARD WILLIAMS, professor of mathematics and dean of the faculty of the Virginia Polytechnic Institute, died on April 19. He was seventy-five years old.

LIEUTENANT COLONEL WALTER W. PLECHNER, assistant director of research of the Titanium Division of the National Lead Co., was killed in action in North Africa on March 4.

WILLIAM R. WEBB, assistant deputy chairman and director of Eastman Kodak, Ltd., England, died on April 16. He was fifty-four years old.

DEAN WILLIAM H. G. LOGAN, of the Dental School of Loyola University (Chicago College of Dental Surgery) since 1920, died of a heart attack on April 6 at the age of seventy years. Dr. Paul C. Kitchin, secretary of the dental subsection of the American Association for the Advancement of Science, writes: "Dr. Logan was an oral surgeon and educator of international reputation and the holder of honorary degrees from the University of Michigan, Loyola University and the National University of Ireland. During World War I Dr. Logan played a prominent part in the establishment of the Army Dental Corps. From 1917 to 1919 he was chief of the Dental Division of the Surgeon General's Office and held the rank of colonel. He was a past president of the American Dental Association (1917–1918) and of the American Association of Dental Schools (1928) and a fellow of the American College of Surgeons."

Nature reports the death of Sir Sidney Burrard, Bart., F.R.S., formerly Surveyor-General of India and superintendent of the Trigonometrical Survey of India, on March 16, aged eighty-two years; of H. G. Denham, dean and professor of chemistry, Canterbury University College, Christchurch, New Zealand, and chairman of the New Zealand Council of Scientific and Industrial Research, aged sixty-two years; of J. Eustice, emeritus professor of engineering at University College, Southampton, on February 24, aged seventy-eight years, and of Dr. F. G. Parsons, research fellow in anthropology at St. Thomas's Hospital, formerly professor of anatomy, University of London, on March 11.

SCIENTIFIC EVENTS

SWEDISH FOREST PRODUCTS

ACCORDING to the Swedish International Press Bureau, as reported in *Nature,* a survey of Sweden's production of forest products of a chemical nature was recently made by Otto Cyren, director of the Swedish Chemical Office. Speaking of chemical pulp, one of Sweden's most outstanding export products in normal times, he said that Sweden is in a very good position in respect of quality, as the slowly growing timber in northerly regions gives very long fibers, and consequently the strongest pulp and paper are obtained from it. The most important by-product of the sulphite pulp production is sulphite spirit, which up to most recent years was the only product recovered. Mixed with petrol, it was of importance as a motor fuel. The purity of the rectified spirit now surpasses that obtained from grain and potatoes, and it is therefore used also for human consumption. Researches on the possibility of using sulphite spirit as the basis of more highly developed products were not initiated until the present crisis made the matter urgent. As an instance he described the work carried on by the

Mo and Domsjo Company. In 1941 this company completed a factory for the production of sulphite spirit with a capacity for 10 million litres of 95 per cent. spirit a year. At this factory intensive research work is going on, with the view of producing various synthetic products from the spirit. From the black lye obtained in the sulphite pulp process there are produced *inter alia* certain crude acids, the first factory for using this raw product having been built at the Bergvik och Ala pulp mill. The sebacic acid produced here, called "pine fatty acid," is used to replace fat in washing mediums, as a substitute for linseed oil in paints, etc.

The output of charcoal in Sweden has trebled in the last couple of years, mainly due to the extensive producer-gas traction of motor-cars, and the by-products from the carbonization are now being recovered more carefully than before. The charring of old tree stumps, with their high content of rosin, alone gives about 20,000 tons of tar a year. Wood tar is now used as motor fuel for fishing boats in place of crude oil, and has probably saved the Swedish high-sea fisheries from total stoppage. It is also used for the production of lubricants. In summing up the situation for the Swedish forest products industry, Mr. Cyren stated that in 1941 the Swedish exports of woodstuffs had declined by about one third, and the pulp and paper by two thirds, compared with the pre-war level. But in compensation the forests, by supplying cattle feed, wood fuel, motor fuel, lubricants, textile material, fatty oils and a good many other useful products, have saved the country from catastrophe.

INDUSTRIAL RESEARCH LABORATORY OF THE UNIVERSITY OF ROCHESTER

AN industrial x-ray laboratory equipped with a million-volt unit, one of the most powerful in the world, has been established at the University of Rochester. The laboratory is the joint enterprise of the university and eight industries. It was formally opened on April 19 with an inspection visit by industrial leaders, educators, scientific men and Army and Navy ordnance department representatives.

Dr. E. E. Charlton, of the General Electric Research Laboratories, who designed the apparatus, said in an address at a dinner in connection with the "open house" that the project represents "a novel and most useful cooperation in the joining of hands of university and industry in the developing of the full use of x-ray in the industrial field."

With the development of million-volt x-ray machines, minute inspection of heavy steel parts is possible in a matter of seconds and minutes, as compared with the hours or days required under the quarter-million volt apparatus used until recently. He continued: "Industry is waking to the potential value of this powerful new development, but this installation in Rochester will most usefully facilitate the exploring of its applicability to many diverse products at the same time that new problems are presented in devising the most efficient means for using this new tool. For instance, it seems most unlikely that the photographic film and the intensifying screen developed for use in industrial x-ray laboratories to-day are the optimum for million-volt radiography."

John H. Clough, president of the General Electric X-Ray Corporation of Chicago and an alumnus of the university, welcomed the enterprise as "recognizing a type and degree of cooperation between industry and an educational institution that I believe is unique in its conception. Certainly the university is to be congratulated upon its recognition and enthusiastic acceptance of a war-time responsibility to assist American industry in the production of materials that will spell victory for the cause of liberty, and the industries of the Rochester area that have participated in the establishment of the new laboratory are to be complimented upon their generous cooperation with an institution that can be the source of much assistance during this period of tremendous pressure on the country's manufacturing abilities and facilities."

He added, "the powerful x-ray apparatus thus made possible studies that provided a guide to manufacturing procedures that are faster and better than anything we have heretofore enjoyed." Beyond the practical value of the new laboratory, in his opinion, is the significant relationship between education and industry "that can lead to advances beneficial not only to themselves, but to all mankind."

The immediate use of the unit at the University of Rochester is to speed production of war materials in local industries by rapid tests of castings, making it possible to detect flaws in pilot castings to determine if the casting technique is correct before starting mass production.

The undertaking was financed by eight Rochester industries, among them Eastman Kodak Company, Rochester Products and Delco Appliance divisions of General Motors; the Pfaudler Company, the Rochester Gas and Electric Corporation, Consolidated Machine Tool Corporation, Symington-Gould Company and the Rochester Brewing Company.

The university supplies the scientific staff to make the tests and is free to use the equipment for research in metallurgy, medicine and engineering. Part of a second million-volt unit is installed in another part of the laboratory for medical research on cancer. The remainder will not be available until after the war.

Dr. Alan Valentine, president of the university, expressed its deep appreciation of the vision and generosity of the industrial heads who made the proj-

ect possible. Not only will the laboratory quicken the war effort, he said, but the collaboration it represents "holds great possibilities for after the war, in the availability of the equipment for research both from a medical and engineering standpoint."

In discussing the prospects for even more powerful x-ray machines, Dr. Charlton said: "We whose task it has been to raise the voltage limitations in x-ray sources are vastly impressed by the advantages which are taking place, and are eager to climb to further heights. We see no fixed barrier to the extension of our present design to considerably higher voltages and already have planned and hope soon to start the construction of a generator which will bring the next upward step. Just as million-volt x-rays have proved so much more advantageous than those of the quarter-million volt formerly used, so it may reasonably be hoped for still further advantages "as we progress into the multi-million volt field. How far that progress may continue before we reach the point of diminishing returns we do not yet know. That is one reason for our growing interest in the 100 million volt electronic accelerator which we have near completion in Schenectady, and our research will give us the answer."

RARE CHEMICALS

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.:

1. iso-thymol (U.S.P.)
2. l-mono-iodotyrosene
3. 1-3,5 di-iodothyronene
4. di-lauroyl peroxide
5. Succinyl peroxide
6. di-butyryl peroxide
7. acetyl benzoyl peroxide
8. pyrophosphate peroxide
9. phenylactic acid
10. phenylpyruvic acid
11. p-hydroxyphenyl pyruvic acid
12. ethylene disulphonate
13. zinc dimethyldithiocarbamate
14. hexammine cobaltic chloride (U.S.P.)
15. sodium penta cyanoammine ferroate pure
16. cobalt thiocyanate
17. p-cyano benzaldehyde
18. indican (relatively pure)

AWARD OF THE NICHOLAS APPERT MEDAL TO DR. PRESCOTT

THE Nicholas Appert Medal was awarded to Dr. Samuel Cate Prescott, emeritus dean of science of the Massachusetts Institute of Technology, at a meeting of the Chicago Section of the Institute of Food Technologists.

The presentation will be made by M. E. Parker, chairman of the Section, at the annual banquet session at the Statler Hotel, St. Louis, Mo., on June 3.

This award was established in 1941 by the Chicago Section, then under the chairmanship of Dr. E. H. Harvey, now chairman of the St. Louis Section. The medalist is elected by a jury of nine leading technologists representing various divisions of the food processing industry from as many different geographical areas. Eligibility for the award is based on preeminence in the field of food technology and on contributions to the progressive development of food manufacture and processing.

During World War I food dehydration for overseas shipment became Dr. Prescott's chief activity as a division chief in the U. S. Department of Agriculture and later as an Army officer. Upon return to peace-time activities, his previous work with the application of low temperatures for food preservation gave him entrance into the field of quick freezing. During the formative years of that industry his counsel and guidance were much in demand.

Since his retirement last June as dean of science of the Massachusetts Institute of Technology, he has again been called into consulting service by the Dehydration Committee of the U. S. Department of Agriculture and by the Research Laboratories of the National Canners Association. At the present time he is active in that work.

As dean of science at the Massachusetts Institute of Technology, Dr. Prescott initiated the International Food Technology Conference at Cambridge, Mass., in September, 1937, and again in June, 1939, which resulted in the founding of the Institute of Food Technologists.

CONFERENCE ON PHYSICS

As the guests of the President of Mexico, General Manuel Avila Camacho, and the Governor of Puebla, Mexico, Dr. Gonzalo Bautista, a group of prominent men of science from the United States will go to Mexico to attend the First National Conference on Physics to be held in Puebla the first week in May.

The call for the conference was issued in October, 1942, by Governor Bautista, the director of the National Astrophysical Observatory at Tonanzintla, Puebla, Señor Luis Enrique Erro and the president of the University of Puebla, Dr. Raimundo Ruiz. It stated that "a people that pretends to secure all the advantages of civilized life can not overlook the progress of physics nor can it substitute the tremendous resources of this science with activity in other fields, no matter how important these may be."

The agenda for the conference embraces four broad points:

Primary Particles of Physical Reality;
Physics in Education;
Physics in Production;
Physics and the Problems of War and Peace.

The Mexican Ambassador to Washington, Dr. Francisco Castillo Nájera, and Governor Bautista of Puebla made an official visit, early this month, to the State of Massachusetts, at which time they delivered the autographed invitations of the President and of the Governor to guests from the United States, through Dr. Harlow Shapley, director of the Harvard College Observatory, whose cooperation with the Mexican Government for a close collaboration between men of science of both countries, was highly praised by both the Ambassador and the Governor in their addresses at the special meeting of the American Academy of Arts and Sciences in Boston, organized in their honor.

In his autographed invitation, President Avila Camacho of Mexico stated that his Government organized the Conference on Physics "inspired by its desire to contribute to the maintenance and advancement of science and culture in the American Continent, as a means to limit the collapse both have suffered in the countries devastated by the present conflagration."

Professor Albert Einstein was one of the invited guests, but his health will prevent his attendance, although he hopes to send a paper to be read at the conference. Among the guests are Dr. S. Chandrasekhar and his wife, from British India, at present residing in this country.

Señor Salvador Duhart, first secretary of the Mexican Embassy in Washington, will proceed to Mexico accompanying the guests of the President and the Governor, all of whom will gather in San Antonio, Texas, the last day of this month, to continue by rail to Mexico City and Puebla.

The new Benioff-vertical seismograph, recently acquired by the State Government of Puebla for the National Astrophysical Observatory at Tonanzintla, will be inaugurated after it has been installed and put into operation by Dr. L. Don Leet, director of the Harvard Seismological Station, who is one of the invited guests.

PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PLANS for the twenty-seventh annual meeting of the Pacific Division of the American Association for the Advancement of Science are almost complete. The dates have been fixed for the period June 14–19, the host institution to be the Oregon State College, Corvallis.

To supplement the preliminary announcement in the issue of SCIENCE for March 5, it might now be stated that there will be three addresses of public interest during the course of the meeting: one by Professor Linus Pauling, president of the division, on the "Relation of Molecular Structure to Biology and Medicine"; the second by Professor Eliot Mears, Stanford University, on "Post-war Problems of the Pacific Area," and the third by Professor Agnes Fay Morgan, University of California at Berkeley, on "Nutrition in Wartime." These addresses will be presented on the evenings of June 15, 16 and 17.

Tuesday, June 15, will be devoted to general sessions. In the morning there will be a divisional symposium on a "Century of Science in the Pacific Northwest," with a group of addresses covering the fields of agriculture, engineering and forestry. In the afternoon several papers in the field of reviews of current research will be presented: *Genetics,* George W. Beadle, Stanford University; *Botany,* A. S. Foster, University of California at Berkeley; *Zoology,* A. R. Moore, University of Oregon, and *Mathematics,* R. M. Winger, University of Washington.

SCIENTIFIC NOTES AND NEWS

DR. VINCENT DU VIGNEAUD, professor of biochemistry at the Cornell University Medical College, has been given the $1,000 award of the Mead Johnson and Company for research on the B-complex vitamins, in recognition of his work on the structure of biotin.

DR. SYLVANUS G. MORLEY, archeologist of the Carnegie Institution of Washington, has been awarded the Loubat Prize of $1,000 of Columbia University.

DR. GEORGE D. BIRKHOFF, Perkins professor of mathematics at Harvard University, has been elected an honorary member of the Royal Irish Academy in the department of science.

DR. H. S. JENNINGS, professor emeritus of the Johns Hopkins University, was presented, on April 8, with a portfolio of letters of greeting from his former students and friends in honor of his seventy-fifth birthday. Dr. Jennings is now at the University of California at Los Angeles.

SIR ALDO CASTELLANI, formerly professor of tropical medicine and head of the department of medicine of the School of Medicine of the Louisiana State University, now Lieutenant Colonel in the Italian Army, has been decorated by the Italian Government for his "abnegation and devotion during the operations in North Africa."

IT is reported in *Nature* that the trustees of the Ray Lankester Fund have appointed Dr. Shu-Ping Chu, of Queen Mary College, University of London, as

investigator for 1943–44 to carry out research at the Plymouth Laboratory of the Marine Biological Association on the effect on the development of marine algae of the presence or absence of different substances in sea water.

THE Council of the American Institute of Nutrition met in Detroit on March 31 in the annual business session. The officers for the coming year are H. B. Lewis, *President;* Icie Macy Hoobler, *Vice-president;* Arthur H. Smith, *Secretary;* W. H. Sebrell, Jr., *Treasurer;* Lydia J. Roberts, Genevieve Stearns and T. H. Jukes, *Councillors.*

DR. CLYDE LEAVITT, assistant dean of the New York State College of Forestry, Syracuse University, who now has leave of absence, will retire on November 1.

DR. GRAHAM PHILLIPS DUSHANE, of the University of Chicago, has been made acting professor of biology at Stanford University to serve during the spring and summer quarters.

IT is reported in *Popular Astronomy* that Dr. Carlos U. Cesco and Dr. Jorge Sahade, of the Astronomical Observatory at La Plata, Argentina, have been appointed volunteer research assistants at the McDonald and Yerkes Observatories and will arrive in the United States in the latter part of the summer. They are being sent by their government to investigate methods in astronomy and astrophysics now in use at the Yerkes and McDonald Observatories. Guido Münch Panagua, of the National Observatory of Mexico at Tacubaya, has been appointed assistant at the Yerkes and McDonald Observatories for one year. He will replace one of the assistants who has left to join the armed forces.

DR. FREDERICK P. KEPPEL, who retired recently as president of the Carnegie Corporation, has been elected a director of the Columbia Broadcasting System.

MAURICE L. MOORE, formerly research chemist in the Medical-Research Division of Sharp and Dohme, Inc., has joined the Scientific Laboratories of Frederick Stearns and Company, Detroit, as director of organic research.

DR. S. C. OGBURN, JR., acting research manager and technical supervisor, in charge of new product development of the General Chemical Company, has been made manager of the Research and Development Department of the Pennsylvania Salt Manufacturing Company. During the past year, he served as Washington representative of the Technical Department of the General Chemical Company. Earlier he was professor and head of the department of chemical engineering and chairman of the division of engineering of Bucknell University.

DR. C. MARTIN WILBUR, curator of Chinese archeology and ethnology at Field Museum, Chicago, has leave of absence to join the staff of the Office of Strategic Services at Washington, D. C., for the duration of the war.

BRIGADIER GENERAL JAMES STEVENS SIMMONS, A.U.S., director of the Preventive Medicine Division of the Office of the Surgeon General, U. S. Army, delivered the John Wyckoff lectures at New York University on April 15 and 16. The titles of the lectures were "The Preventive Medicine Program of the United States Army" and "The Present State of the Army's Health."

DR. HARLAN TRUE STETSON, of the Massachusetts Institute of Technology, gave the address at the University of Maine on April 15 in a celebration program commemorating the quadricentennial of the death of Copernicus. The occasion was under the auspices of Sigma Xi, and the subject of the lecture was "The Earth and Sun: from Copernicus until To-morrow."

DR. OTTO LOEWI, research professor of New York University, gave a series of lectures and conferences recently at the Ohio State University under the auspices of the Graduate School and the Society of Sigma Xi.

DR. LAURENCE H. SNYDER, of the Ohio State University, addressed on March 31 the colloquium of the Yerkes Laboratories for Primate Biology at Orange Park, Fla. He spoke on "Heredity in Apes and Man."

IN an article by Dr. Henry, entitled "Doctorates in Science," in the issue of SCIENCE for April 9, Dropsie College is referred to as primarily theological. The Dropsie College is a postgraduate, scientific institute in Hebrew and Semitic civilization, non-sectarian and non-theological in nature.

DR. FRANK E. E. GERMANN, executive secretary of the Southwestern Division of the American Association for the Advancement of Science, has announced its decision that owing to war conditions it is inadvisable to hold the annual meeting at Colorado Springs. It is planned to extend the terms of the present officers until such time as the next meeting can be held.

THE Midwestern Psychological Association, by a vote of 123 to 6, has decided to suspend all meetings, elections of officers and new members and collection of dues, until the wartime restrictions on travel are removed. The normal activities of the association will be resumed at the end of the war when the officers will call a meeting. The newly elected president is Professor S. L. Pressey, of the Ohio State University;

the newly elected member of the council is Professor M. A. Tinker, of the University of Minnesota.

UNDER the auspices of the Pittsburgh Committee for the Copernican Quadricentennial, the Polish Institute of Arts and Sciences, now playing the role of the Academy of Science in Exile, will hold three conferences on pure and applied science at Mellon Institute during the week of the celebration, which will be held from May 11 to 13. *A Conference on Pure Science* will be held on May 11 at 4:30 P.M., when the speakers will be Dr. Mrzowski, of the University of Chicago, and Dr. O. E. Jennings, head of the department of biology, University of Pittsburgh, curator of botany and director of education, Carnegie Museum; *A Conference on Applied Science* on May 11 at 8:15 P.M., at which T. Sendzimir, metallurgical engineer, and Dr. H. H. Lowry, director, Coal Research, of the Carnegie Institute of Technology, will speak; *A Conference on Nutrition* on May 12 at 2:30 P.M., at which the speakers will be Dr. Maria Gutowska, Massachusetts State College, and Dr. Herbert H. Longenecker, professor of biochemistry, director of the Buhl Foundation Research Projects, University of Pittsburgh.

THE research conferences to be held this summer at Gibson Island under the auspices of the American Association for the Advancement of Science include a symposium on "Hormones," to be held from July 19 to July 23, with F. C. Koch, Armour and Company, Chicago, chairman, and H. Jensen, the Upjohn Company, Kalamazoo, vice-chairman. The speakers will include A. White, Yale Medical School; B. Chow, the Squibb Institute for Medical Research; George W. Irving, U. S. Department of Agriculture, Southern Regional Research Laboratory, New Orleans; C. N. H. Long, Yale Medical School; M. H. Kuizenga, Dwight J. Ingle and H. Jensen, the Upjohn Company; F. D. W. Lukens, University of Pennsylvania; W. T. Salter, Yale Medical School; Thomas R. Wood, University of Pittsburgh; T. F. Gallagher, University of Chicago; E. Schwenk, Schering Corporation, Bloomfield, N. J.; S. Gurin, University of Pennsylvania; H. L. Fevold, U. S. Department of Agriculture, Western Regional Research Laboratory, Albany, Calif.; Louis Levin, College of Physicians and Surgeons, Columbia University; K. W. Thompson, Yale Medical School, and F. C. Koch. Requests for additional information should be addressed to the director of the conferences, Dr. Neil E. Gordon, Wayne University, Detroit, Mich.

THE British Association held a conference at the Royal Institution on March 20 and 21 to discuss "Science and the Citizen: the Public Understanding of Science." Sir Richard Gregory, the president, opened the conference, and in addition to members of the association scientific men from the British oversea Empire, representatives of the allied nations and others interested in scientific movements attended. The subjects at the four sessions were, respectively, the exposition of science, radio and cinema, science as a humanity, and science and the press. Sir Henry Dale, president of the Royal Society and director of the Royal Institution, presided at the first session; the chief speakers were Sir Lawrence Bragg, Professor Allan Ferguson and Professor J. A. Lauwerys. A message was read from Sir John Anderson, Lord President of the Council.

IT is stated in the daily press that ninety-six institutions and agencies throughout the United States will receive gifts amounting to $1,945,000 under a deed of trust from the estate of Louis D. Beaumont, valued at $13,000,000. He was one of the founders of the May Department Stores Company, a national chain, who died in New York last October 1. The residual estate will be divided among charitable, literary, scientific, educational and religious organizations to be selected. Among the cash bequests are $200,000 to Western Reserve University, and $100,000 each to St. Louis University and Washington University, St. Louis, and the University of Denver.

THE *Journal* of the American Medical Association states that the William Buchanan Foundation of Texarkana has given to the University of Texas $200,000 for a five-year program on child health. The details were concluded at a meeting in Galveston, Texas, between Dr. Stanley J. Seeger, Texarkana, president of the foundation, and Dr. Chauncey D. Leake, dean of the medical branch. The program will be worked out in conjunction with the department of pediatrics of the medical branch, correlating the activities of the department of other state and national agencies. Its purpose is to afford the profession in Texas an opportunity to maintain the latest methods in connection with the promotion of child health, especial attention to be given to the problems of the adolescent in wartime.

ONE TENTH of the residue of the estate of the late Sir Edward Beatty, a former president of the Canadian Pacific Railway, has been bequeathed to McGill University. The university will also receive Sir Edward's library.

THE National Research Council announces the award for the academic year 1943–44 of fourteen fellowships of the value of $750 each, thirty studentships of $650 each and twenty-one bursaries of $250 each. The group of sixty-five successful candidates for these postgraduate scholarships comprises graduates of fifteen Canadian universities who will conduct

research work in the coming year at eleven of these institutions. As a result of war conditions, the fields of science in which the scholarship holders will work are reduced in number as compared with a few years ago. By far the greatest number will work in various branches of chemistry related to the war effort. Smaller numbers will work in physics, engineering and other subjects largely connected with war research.

DISCUSSION

DESTRUCTION OF RED BLOOD CELLS AFTER FAT INGESTION

JOHNSON and Freeman[1] have shown that the thoracic duct lymph of dogs fed fat is markedly hemolytic. Fatty acids and soaps, which have presumably escaped resynthesis into neutral fat during absorption, are present in duct lymph in quantities sufficient to account for the hemolysis observed.[2]

Although this lymph empties but slowly into the blood stream, after a fat meal the circulating red blood cells become exposed to a sufficient quantity of the hemolytic agent to cause an acceleration of the normal daily red blood cell destruction, so that in dogs[3] and in man[4] the daily excretion of the degradation products of hemoglobin is greater on a high fat diet than on a low fat diet.

More directly, Longini, Freeman and Johnson[5] have demonstrated in dog's lipemic blood the presence of an agent which increases the fragility of red blood cells.

It has now been possible to show that drinking one pint of 32 per cent. cream (150 cc of fat) causes human serum to become injurious to red blood cells, increasing their fragility. Details of this experiment will be published elsewhere.

Although the extra blood destruction resulting from fat ingestion seems to be insufficient to produce anemia in normal individuals, whose bone marrow is capable of replacing these extra cell losses, it remains to be determined: (1) whether regeneration of red cells after blood loss, when the bone marrow is excessively taxed, might be hastened by a low fat diet, and retarded by a high fat diet, or (2) whether abnormalities in fat absorption or abnormal sensitivity of cells to the hemolytic agent described might contribute to the production of certain human anemias not associated with blood loss.

These possibilities are under investigation in this laboratory.

VICTOR JOHNSON
JOAN LONGINI
L. WILLARD FREEMAN
THE UNIVERSITY OF CHICAGO

[1] Victor Johnson and L. W. Freeman, *Am. Jour. Physiol.*, 124: 466, 1938.
[2] L. W. Freeman and Victor Johnson, *Am. Jour. Physiol.*, 130: 723 1940.
[3] L. W. Freem[illegible], A. Loewy, A. Marchello and Victor Johnson, *Fed. P[illegible].*, 1: 25, 1942.
[4] H. W. Josephs, L. E. Holt, H. C. Tidwell and C. Kajdi, *Jour. Clin. Invest.*, 17: 532, 1938.
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GONADAL HORMONES IN SNAKES

ANDROGENIC and estrogenic content of the gonads of several vertebrates has been tested since the work of Allen and Doisy,[1] Martins and Rocha e Silva,[2] Moore, Gallagher and Koch.[3] Also the gonads of ovoviviparous snakes contain these substances. We have assayed an alcoholic extract from the testes and ovaries of 324 *Bothrops jararaca* and *Crotalus terrificus terrificus.* The residue of alcoholic distillation was extracted by ether, this evaporated and the oil matter so obtained mixed with arachnis oil.

Assays for androgens were made in spayed colchicine treated rats, according to the method first described by Martins[4] and in Leghorn white capons by the comb method. With a total dose of 10 mg of testicular tissue in 1 cc of arachnis oil, a positive effect was observed in both tests.

Assays for estrogens made by the Bülbring and Burn technic,[5] with estrone in parallel, gave a concentration of 2,000 estrone units per kg of fresh ovaries, a value in accord with that mentioned by Fraenkel and Martins.[6] Tests on capons for possible androgens in ovarian extract after estrogenic separation were negative.

As Porto,[7] also in this laboratory, found progestational substances in the corpora lutea of the same *Crotalidae,* we can say that gonads of those snakes contain the three kind of sexual hormones.

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[1] E. Allen and E. A. Doisy, *Jour. Am. Med. Assn.*, 81: 819, 1923.
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[3] C. R. Moore, T. F. Gallagher and F. C. Koch, *Endocrin.*, 13: 367, 1929.
[4] Th. Martins, *C. R. Soc. Biol.*, 126: 131, 1937.
[5] E. Bülbring and J. A. Burn, *Jour. Physiol.*, 85: 320, 1935.
[6] L. Fraenkel and Th. Martins, *Mem. Inst. Butantan*, 13: 393, 1939.
[7] A. Porto, *Mem. Inst. Butantan*, 15: 27, 1941.

NAMES, RUSSIAN AND OTHER

THE note by Dr. Hrdlička on "Russian Names" (in SCIENCE of March 12) raises a point in a problem of

wider scope which I have thought for some years was in need of elaboration. The rendering of words from a language in which the Latin alphabet is not used into English, has become a source of great confusion. Too often a rendering into French or German is simply transliterated into English, and the values of the letters are then different from the common English sounds; so that without a key the reader is at loss. I do not know what languages our English spellings of Chinese words were transliterated from; but certainly without a key to tell one that, for example, *Chiang* is pronounced approximately *Jang,* and that *Tao* is sounded *Dow,* one would be misled. An entertaining example is the literal taking over of the French spelling of the Arabic word for mountain: *Djebel.* Of course the *D* is essential in French but redundant in English, since the English *J* has the sound which can be written in French only by *Dj.* This has made some radio commentators comic. The appalling confusion in English renderings of Sanscrit words is well known to Sanscrit scholars.

Our English spellings of Russian words appear to be transliterations of German renderings, and these transliterations are often absurd. In "Pawlow," the *w,* as Dr. Hrdlička points out, does not indicate the usual sound of the letter in English: and this spelling has misled many students. Since we do not use the Russian alphabet, and the Russian letter which Dr. Hrdlička calls "v" is not the English *v* why not be sensible and write *Pavloff?* After all, English is a language in its own right.

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SCIENTIFIC BOOKS

THE SCIENCE OF WORDS

Webster's Dictionary of Synonyms. 1st edition. A Dictionary of Discriminated Synonyms, with Antonyms and Analogous and Contrasted Words. xxxiv + 907 pp. Springfield, Mass.: G. and C. Merriam Co. 1942. $3.50 ($4.00 with thumb index).

There are a great many obstacles to precision in writing. Many writers, for example, seem to have personal prejudices against certain words and irrational predilections for others—attitudes passed on to them perhaps by some pedantic schoolmaster or half-cocked editor. Others have a leaning toward polysyllables, clothing their ponderous brain children with even more ponderous diction, until their sentences drag along like dull overladen beasts of burden. Still others boast that they never use a "big" word if they can find a "little" one, ascribing some specious virtue to the monosyllabic word *per se.* There are some, too, who in their writing adhere so literally to Pope's well-meaning but dangerous injunction—

> Be not the first by whom the new are tried,
> Nor yet the last to lay the old aside.

—that their vocabulary reminds one of a crowded room with all the windows shut and barred. Precision is attained, once wrote Ambrose Bierce, "by choice of the word that accurately expresses what the writer has in mind, and by exclusion of that which either denotes or connotes something else. As Quintilian puts it, the writer should so write that his reader not only may, but must, understand." To achieve that, the writer must make use of the English language in all its motley, big words and little, new and old.

That is why, I believe, it would be a fine thing if this new Dictionary of Synonyms were available to every scientist in the land, for sooner or later scientists become writers, and whether they know it or not they must be students of semantics. Any work of scholarship that helps them in their quest for exactitude, whether in the science process itself or in the communication of knowledge, becomes indispensable.

The book itself is an entirely new work, written chiefly by Miss Rose F. Egan, assistant editor on the permanent staff of the G. and C. Merriam Company. Mr. Hubert P. Kelsey wrote many of the articles on scientific terms. Articles dealing with law, chemistry and medicine were reviewed, respectively, by Dr. Roscoe Pound, of Harvard University; Dr. Austin M. Patterson, of Antioch College; and Dr. Esmond R. Long, director of the Henry Phipps Institute.

A brief account of the plan of the book will here suffice. Four categories of words are distinguished, as follows:

(1) Synonyms. A synonym is defined as "one of two or more words in the English language which have the same or very nearly the same *essential* meaning"; it is assumed, of course, that an absolute synonym rarely if ever occurs. Furthermore, not all the words discriminated are synonyms. "A few articles discuss a group of words that are sometimes wrongly taken as synonyms because they are confused or their actual meanings are misunderstood or because they once had one or more meanings which made them synonymous."

(2) Antonyms. An antonym is defined as "a word so opposed in meaning to another word, its equal in breadth or range of application, that it negates or nullifies every single one of its impressions."

(3) Analogous words.

(4) Contrasted words.

Thus, under the word *malign,* although the words *malign, traduce, asperse, vilify, calumniate, defame,*

slander and *libel* are considered synonymous, a whole column is devoted to explaining and illustrating the distinctions between them. Analogous words in this case are: *detract from, decry, disparage, depreciate, derogate from, vituperate, revile, defile, pollute.* The antonym is *defend.* Contrasted words: *vindicate, justify, maintain, extol, eulogize, praise.* Some of these words are cross-referenced to other articles where further information is presented.

The Dictionary is well up-to-date. Under the article on the word *drunk,* for example, one finds this comment: "There are many slang terms that imply intoxication: most of them, such as *spiflicated* (or *spifflicated*), *soused, lit,* and *blotto,* are strong in their implications, suggesting loss of powers of locomotion, recognition, speech, and the like."

An indication of the careful and scholarly way in which the various words are distinguished is the wealth of illustrative citations from English and American literature, ancient and modern. Under the word *malign* again, no less than eleven quotations are included to illustrate differentiations in meanings of the synonyms, the authors ranging from classical English writers—Shakespeare, Burke, Scott, Meredith, Tennyson—to such contemporary writers as John Buchan and Van Wyck Brooks. An impressive list of all the authors quoted (at least 1,000, with full names and dates) is appended. Another feature of the Dictionary is the introductory "Survey of the History of English Synonymy," an informative and fundamental chapter for any one interested in the science of words or who wants to know how this dictionary differs from its predecessors. Typographically, the book has been punctiliously put together, the result being an unusually clear and readable page. The main text is printed in 7-point monotype Binney on an 8-point body, double column.

Although precision may be the chief objective for any writer who treats of philosophical subjects, the scientist who tirelessly expands his vocabulary and becomes increasingly sensitive to the subtleties of language will find that perspicuity is not the only reward. He will find himself developing also a richness of style to enhance his expression. He will find that where he used to repeat the same word two or three times in a single sentence, there will spring to his mind half a dozen others to choose from. He will discover himself spending quarter-hours at a time searching for the right word. And when he has finished his sentence, his chapter, his book, he may truly realize what is meant by the old apothegm, "Easy reading, hard writing."

Besides which, for every writer, whether he be scientist, historian, novelist or poet, there is a peculiar artistic satisfaction in having said (if indeed he ever does) exactly what he set out to say. Every writer worth his salt has fallen in love with words, and he woos them ardently. This new Dictionary of Synonyms, whose publication seems to me a real event, should help to "marry off" many an elusive word to "her" new master.

PAUL H. OEHSER

U. S. NATIONAL MUSEUM

AUTONOMIC REGULATIONS

Autonomic Regulations. Their Significance for Physiology, Psychology and Neuropsychiatry. By ERNST GELLHORN. New York: Interscience Publishers, Inc. 373 pp. 80 figs. 1942.

INTERRELATIONS of organ systems is attracting the attention of physiologists more and more as the knowledge of the nervous and endocrine systems increases. The study of the organism as a whole is the ultimate goal.

In the present work, "those organs which are influenced by the autonomic system and affect it in turn are subjected to a physiological analysis. Consequently, the relationship between hormones and the autonomic nervous system is investigated." The mutual relation between the autonomic and somatic nervous systems is discussed. It is shown that the autonomic system is afferent as well as efferent, influencing the excitability of the somatic system. An analysis of emergency conditions indicates that the vago-insulin system, as well as the sympathetic-adrenal system, is involved.

This book evolved as a result of lectures and research during the past nine years. The great amount accomplished by Gellhorn and his associates is indicated by the fact that three fourths of the figures are from his laboratory. However, the large number of references (1,100) shows that he has drawn freely on the work of other investigators.

Approximately the first third of the book is devoted to adjustment reactions involving primarily the respiratory and circulatory systems in response to carbon dioxide, anoxia, asphyxia, hemorrhage and hypoglycemia with a chapter on the regulation of cerebral circulation.

This is followed by discussions of the nervous regulation of the hypophysis and the role of the sympathetico-adrenal and vago-insulin systems.

The next part deals with autonomic-somatic integration. The role of the sympathetic and parasympathetic systems in anoxia, hypoglycemia and hemorrhage is covered in one chapter, while a second chapter deals with the differences in the reaction of the autonomic and somatic nervous systems and a third is

concerned with the relation between these two systems and its significance in convulsions. The fourth chapter of this part is on the autonomic basis of emotion.

The last part, on results and applications, begins with two very good chapters on the principles of autonomic organization and on organismic physiology. There is a chapter on anesthesia, and one headed "The autonomic nervous system and neuropsychiatry," which is an attempt to analyze the effects of various procedures used in the treatment of schizophrenia. A good summary at the end of each chapter is helpful to the reader. The book is a distinct contribution to the literature.

FRANK A. HARTMAN

REPORTS

GENERAL COUNCIL ON ZOOLOGICAL NOMENCLATURE

THE undersigned zoologists, resident in the United States of America, at the invitation of the Committee on Nomenclature of the American Society of Mammalogists and with the cooperation of the "American Commission on Scientific Nomenclature" of the Entomological Society of America, do hereby associate themselves together as a society and certify as follows:

First: The name of the society shall be the General Council on Zoological Nomenclature.

Second: The objects of the society shall be:

(A) To act in an advisory capacity in all matters concerning zoological nomenclature during the World War and for such time thereafter as it may consider desirable.

(B) To administer, amend, interpret, and maintain a code of nomenclature for the use of zoologists.

(C) To cooperate with societies maintaining committees on nomenclature, at least those represented in its own membership.

(D) To retain within itself important powers of decision and legislation and of substitutions and additions to its membership, but always subject to full hearings and the advice and counsel of one or more of the committees above mentioned.

(E) To cooperate with zoologists practised in nomenclature who are residents of foreign countries when the war is ended or as soon thereafter as may be practicable.

G. F. FERRIS
WILFRED H. OSGOOD
JAMES A. G. REHN
GEORGE G. SIMPSON*
JOHN T. ZIMMER
REMINGTON KELLOGG
H. A. PILSBRY
KARL P. SCHMIDT
A. WETMORE

Merely on the face of it, the above may seem to be a self-constituted body of dubious possibilities and audacious construction. That this is not the case may be evident when its history and purposes are explained. It is the outgrowth of numerous informal discussions among a large number of zoologists during the past few years and of formal action taken by at least two national societies.

Even in years just prior to the war, the International Commission on Zoological Nomenclature was relatively inactive and after hostilities began in Europe in 1939 it became practically non-functional. This created a situation in which all cooperative action was endangered and nearly a century's hard-earned progress in nomenclature was threatened. Individuals and organizations began to discuss special codes for their separate groups only and in some cases took definite action. Recently a German (Poche) has promulgated a code of his own and in general at the moment every zoologist having a nomenclatural problem finds himself without appeal to any constituted authority. It was precisely to avoid this condition that codes and commissions were devised.

Discussion among zoologists unanimously recognized the emergency, but it was difficult to arrive at a basis for action which did not involve very great delay and long-drawn controversy. There were those who felt that the international idea could not be abandoned and others who advocated complete divorce from the Old World. The latter pointed to the success of the International Commission as being mainly due to the American, C. W. Stiles, whose final conclusion (see SCIENCE, 73: pp. 349–354, 1931) was that it was not further workable. Among those holding this opinion were several Europeans.

As announced in SCIENCE (June 12, 1942) the Entomological Society of America, pursuant to action taken at its meeting in December, 1941, formed an "American Commission on Scientific Nomenclature in Entomology" apparently with the object of proceeding independently. Somewhat later at its annual meeting in April, 1942, the American Society of Mammalogists instructed its standing committee on nomenclature "to act pro-tem in the present world crisis for the Committee [sic] on Nomenclature of the International Commission." The Mammalogists' committee felt that any committee restricted to a particular branch of zoology would be ineffective. Therefore, with the approval of the society's president and principal directors, this committee entered into correspondence with the entomologists proposing that the two committees, without further authorization, jointly

* Dr. Simpson's signature is assumed on the basis of his verbal agreement before he left for war service where he can not now be reached.

sponsor the selection of a small group of representative nomenclaturists to "take over," at least for the time being. Full cooperation between the two committees proved impractical without great loss of time, so the Mammalogists' committee, after receiving the approval of the majority of the entomologists, selected and organized the group as indicated above. The membership of the Mammalogists' committee which carried this out was as follows: A. Cabrera, E. R. Hall, G. S. Miller, Jr., W. H. Osgood, T. S. Palmer, G. G. Simpson and G. H. Tate.

The "Council" thus formed is frankly experimental and the method of its genesis is unusual, but those responsible for it have felt that any other method, especially in these times when large general meetings are interdicted, would defeat itself in prolonged discussion and fatal delay. Under restrictions which the Council has placed upon itself it is hoped that it may be a wholly representative and cooperative body. A brief set of by-laws has been adopted in which important provisions are to the effect (1) that the active membership shall not exceed fifteen, (2) that additions and replacements shall be made only from candidates nominated by large associations of zoologists, and (3) that no important action can be taken without first obtaining the opinion of at least two nomenclatural committees of national societies and several individuals not members of the Council. A judicial function is thus implied preceding any legislation.

It does not propose to supersede any existing special nomenclatural committees, but on the contrary it is designed to stimulate them to greater interest and more action. Its post-war status is problematical, but at least as a temporary measure and an effort in a direction urgently needing attention, it is hoped it may find support. At an early date it is proposed to increase the membership from nine to eleven in order to cover important branches of zoology which are not now well represented.

The by-laws giving details of proposed action will soon be available for distribution to any interested zoologists who may apply for them.

WILFRED H. OSGOOD,
Secretary

SPECIAL ARTICLES

ISOLATION OF THE ANTIANEMIA FACTOR (VITAMIN Bc) IN CRYSTALLINE FORM FROM LIVER*

SOMETIME ago Hogan and Parrott[1] pointed out that under certain dietary conditions chicks fail to grow, and develop a severe anemia which can be cured with liver extracts. They recognized the responsible factor as being an unidentified member of the B complex and for convenience designated it vitamin Bc. O'Dell and Hogan[2] developed an assay procedure with chicks, and succeeded in concentrating the factor in crude liver extract about sixty-fold.

In the fall of 1940 we undertook the isolation of this vitamin. We have recently succeeded in obtaining the compound in pure form. It crystallizes from water in orange-colored spherulites which exhibit typical parallel crossed extinction. After repeated recrystallization it separates in clusters of thin yellow spear-head shaped platelets.[3] It does not melt below 360° C. but darkens and chars from about 250° C. Analysis of an ash-free specimen gave the following percentage composition: C 50.50, 50.63; H 4.78, 4.78; N 19.91.

The compound yields a crystalline methyl ester which has no melting point, contains less than 5 per cent. of the activity of the original acid and can be converted back to the crystalline acid.

When the crystalline acid is administered to day-old chicks on a prophylactic test[4] at a dosage level of 2.5γ per gram of deficient ration the chicks grow normally and at the end of 4 weeks exhibit no anemia. Studies under way will establish the minimum dosage level necessary. The data in Table I summarize the results of a preliminary demonstration of its potency on the chick.

TABLE I
BIOLOGICAL RESPONSE TO CRYSTALLINE VITAMIN BC

	No. of chicks	Level per gm of ration	28-day test: Hgb. gm 100 cc	Per cent. Hematocrit	Weight (gm)
1. Basal ration (negative controls)	127	...	5.51*	14.2	75.8
2. Broiler ration (positive controls)	18	...	....	27.7	169.5
3. Basal ration + crude concentrate	16	0.18 cc	9.90*	29.7	191.1
4. Basal ration + semi-pure fraction	4	5.0γ	....	32.5	198.5
5. Basal ration + vitamin Bc (crystals)	9	2.5γ	10.95*	30.1	196.3

* Number of chicks tested was 11, 6 and 6, respectively.

* This article was received for publication on April 8, 1943.

1 A. G. Hogan and E. M. Parrott, *Jour. Biol. Chem.*, 132: 507, 1940; 128: Proc. xlvi, 1939.

2 B. L. O'Dell and A. G. Hogan. In press.

3 A complete crystallographic description will be given later by Professor C. B. Slawson, of the University of Michigan.

4 The details of this method will be published elsewhere by Mr. C. J. Campbell, whose valuable assistance on the animal assay work is hereby acknowledged.

During the course of this work Mills, Briggs, Elvehjem and Hart[5] reported that a concentrate from liver representing Peterson's "eluate factor"[6] was potent as a growth factor in chicks and that it also prevented the development of anemia (low hemoglobin). On the basis of the above observations these authors suggested that Hogan's antianemia factor and Peterson's "eluate factor" might be identical. They also pointed out the similarity between the two factors with respect to their alcohol insolubility and adsorbability on Fuller's earth at acid pH levels. Following the appearance of this publication, we assayed our concentrates of the antianemia factor by the microbiological growth method and found them to be highly active in growth factor activity for *Lactobacillus* ε (Peterson's "eluate factor"). The repeatedly recrystallized vitamin produces approximately half-maximum growth of *Lactobacillus casei* ε in a concentration of 0.00005γ per cc of culture media. These observations demonstrate conclusively the identity of Hogan's antianemia factor and Peterson's "eluate factor."

Likewise, during the course of our isolation work on the antianemia factor, Mitchell, Snell and Williams[7] reported the preparation of a concentrate from spinach which was very active in stimulating the growth of *Streptococcus lactis R.* or *Lactobacillus casei* ε in comparable dosage. They expressed the opinion that they had "what appears to be a nearly pure chemical entity." They stated that it contained nitrogen, no sulfur or phosphorus and had a molecular weight of 500 as determined by diffusion methods and suggested the name *folic acid* for this microbiological growth factor. Peterson[4] has discussed the probable identity of his "eluate factor" with the "folic acid" factor of Williams. It appears probable that the chick antianemia factor, Peterson's "eluate factor" and Williams' "folic acid" factor are the same. We shall discuss later the chemical identity of the chick antianemia factor from animal with that from plant sources.

Since Hogan and his collaborators discovered the vitamin nature of the chick antianemia factor in liver[1,2] and applied the convenient designation vitamin Bc, we propose the retention of this term for the pure crystalline compound from liver until such time as chemical knowledge of the substance may suggest a more suitable name.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

QUANTITATIVE MICRO-ESTIMATION OF ANTIBODIES IN THE SERA OF MAN AND OTHER ANIMALS[1]

QUANTITATIVE micro-methods for the determination of antibody nitrogen, conforming to the rigid criteria of analytical chemistry and involving the use of the micro-Kjeldahl or Teorell procedures have been available for some years.[2, 3, 4] These methods reach their greatest degree of accuracy with quantities of antibody nitrogen ranging from 0.1 to 1 mg. There is need, however, for a procedure which could be carried out with one fifth to one tenth these amounts, particularly in the case of human sera, in which the antibody content in health, immunity or disease is not likely to be large. The present method, developed to meet this need, has been in use in this laboratory for more than a year and has consistently yielded reproducible results. The principal departures in technique from the earlier method are precautions to ensure sterility during the relatively long period before the precipitates are washed, and colorimetric estimation of the nitrogen. Depending upon the results of preliminary tests three 1 to 4 ml portions of serum are used.

Use of the Folin-Wu-Ciocalteau phenol reagent for the estimation of proteins was advocated by Wu,[5] developed by Anson,[6] rendered more sensitive by Herriott[7] through the addition of minute amounts of copper ion, and further adapted to micro-analysis by

[5] R. C. Mills, G. M. Briggs, Jr., C. A. Elvehjem and E. B. Hart, *Proc. Soc. Exp. Biol. and Med.*, 49: 186, 1942.

[6] B. L. Hutchings, N. Bohonos and W. H. Peterson, *Jour. Biol. Chem.*, 141: 521, 1941; E. E. Snell and W. H. Peterson, *Jour. Bact.*, 39: 273, 1940.

[7] H. K. Mitchell, E. E. Snell and R. J. Williams, *Jour. Am. Chem. Soc.*, 63: 2284, 1941.

[1] From the Department of Medicine, Columbia University, College of Physicians and Surgeons, and the Presbyterian and Babies Hospitals, New York City. Aided in part by a grant from the Commonwealth Fund.

[2] M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 50: 809, 1929; M. Heidelberger, R. H. P. Sia and F. E. Kendall, *Jour. Exp. Med.*, 52: 477, 1930.

[3] M. Heidelberger, F. E. Kendall and C. M. Soo Hoo, *Jour. Exp. Med.*, 58: 137, 1933; M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 61: 559, 1935; M. Heidelberger and E. A. Kabat, *Jour. Exp. Med.*, 60: 643, 1934.

[4] M. Heidelberger, F. E. Kendall and T. Teorell, *Jour. Exp. Med.*, 63: 819, 1936.

[5] H. Wu, *Jour. Biol. Chem.*, 51: 33, 1921.

[6] M. L. Anson, *Jour. Gen. Physiol.*, 22: 79, 1938–39.

[7] R. M. Herriott, *Proc. Soc. Exp. Biol. Med.*, 46: 642, 1941.

Altschul.[8] Washed specific precipitates containing as little as 1 γ of N yield a definite blue color by the modified method and this may be read in a photoelectric colorimeter or a spectrophotometer[9] at $\lambda = 650$.

Since heat-inactivation may damage antibody in weak antisera,[10] complement, which may add nitrogen to certain specific precipitates,[11] is removed by addition of an antigen and the corresponding rabbit antibody unrelated to the immune system to be analyzed. These may be added either separately or in the form of finely divided specific precipitate suspended in saline. For analyses of antibodies to pneumococci of many types and influenza bacilli, egg albumin (Ea) and rabbit anti-Ea are used in this preliminary step. After centrifugation of the Ea-anti Ea precipitate the supernatant is divided into three equal portions, one of which serves as a blank. To the other two a slight excess of specific polysaccharide (usually 0.005 to 0.02 mg, as indicated by the preliminary tests) is added and the serum and solution are thoroughly mixed. Conical centrifuge tubes of about 8 ml capacity are convenient to use. After one half to one hour at 37° C the tubes are placed in the refrigerator for a week or ten days. Centrifugation and washing in the cold are carried out as in previous papers.[3,4] The blanks and precipitates are then taken up in water, treated with 0.2 to 0.3 m of 0.1 *N* NaOH until the precipitates are dissolved, and made up to 2.5 ml or more, depending upon the amount of precipitate. Aliquots of 2.0 ml are mixed with 6 ml of clear 12.5 per cent. Na_2CO_3 solution and allowed to stand for 1 hour to ensure maximum color development later. 1 ml of Folin reagent freshly diluted with two parts of water is then added. After 20 to 30 minutes the duplicates may either be read directly against the blank, with the latter set at 0 optical density or 100 per cent. transmission, or all tubes are read against a blank of 2 ml of water to which the above reagents have been added. Optical densities are read and converted into antibody N by means of a factor obtained with known amounts of antibody N. The optical density is proportional to the amount of antibody N, but may differ for antibodies of the different animal species and may not be the same as that of normal globulin. Indicated differences in the color values will be studied in greater detail. Table I gives representative analyses carried out by earlier modifications of the method differing in detail.

TABLE I

Species, Serum Volume	Specific polysaccharide and amount used		Optical density*	Factor for conversion to N	Factor for calculation of aliquot to standard vol.	Antibody N per 4 ml serum
ml		*mg*				*mg*
Man, 4.5	Pneumococcus "C,"	0.02	0.320	0.0642	1.445	0.030
" "	" III,†	0.01	0.118	0.0642	1.2	0.008
Horse, 0.5	" "C,"	0.015	0.497	0.0746	10	0.371
Rabbit, 1 (1:10)	*H. influenzae*, B,	0.007	0.522	0.0698	66.8	2.44

* Negative logarithm of transmittance.
† After preliminary absorption with "C" substance.

A more detailed account of the method, its possibilities and its limitations is in preparation.

SUMMARY

A micro-method is described by which as little as 10γ of specific precipitate nitrogen may be determined with a fair degree of accuracy. The error in repeated determinations is about ± 2γ.

MICHAEL HEIDELBERGER
CATHERINE F. C. MACPHERSON

[8] A. M. Altschul, personal communication.
[9] A Coleman Universal spectrophotometer was used in these studies.
[10] Unpublished experiments in this laboratory.
[11] (a) M. Heidelberger, *Jour. Exp. Med.*, 73: 681, 1941; (b) M. Heidelberger and M. Mayer, *Jour. Exp. Med.*, 75: 285, 1942.

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SCIENCE NEWS

Science Service, Washington, D. C.

SPIRAL NEBULAE

THE arms of spiral nebulae, those gigantic pinwheels of the universe, have been discovered to be trailing their central region by Dr. Edwin Hubble, of the Mt. Wilson Observatory. His investigation, reported in the *Astrophysical Journal*, is of importance in the study of the origin and development of nebulae, the most familiar of which is the Milky Way.

Spiral nebulae, comparable in size to our stellar system, are millions of light-years away. Billions of stars, luminous gaseous matter, and dark clouds obscuring portions of the brilliant center form this whirlpool of light.

Dr. Hubble slips the missing piece of the puzzle into place by developing a criterion for determining the direction in which these whirling masses are inclined. We see them as images projected against space and whether they are tilted toward us or away would decide, in light of their spiral pattern, if the arms are trailing or leading.

It has been believed for some time that the dark lanes visible only on the slightly tilted nebulae are the key, but dispute arose as to whether they marked the far or near side. Working with the entire collection of Mt. Wilson photographs, including those made with the aid of the famous 100-inch telescope, Dr. Hubble eventually found a spiral nebula which showed both the dark lanes and the spiral pattern. The dark lines were silhouetted against the central or nuclear bulge, showing that the dark bands unmistakably denote the nearer side. Other nebulae studied support his assumption that the arms were trailing.

From the slant of the spectral lines it is known that all spiral nebulae are traveling in the same direction. Having once determined that direction, Dr. Hubble concluded that the arms of the nebulae are trailing in all spirals.

NEW COSMIC RAY THEORY

COSMIC rays are due to protons which plunge into the earth's atmosphere from outer space, and the proton splits into ten mesotrons. This is the latest theory which Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute, proposes in *The Physical Review*.

Dr. Swann has long contended, in company with many other distinguished physicists, that the incoming particles responsible for the rays are protons. Others have contended that they were high-speed electrons. He now adds a further detail to the theory, that the proton splits into ten mesotrons. This theory, he believes, is the only one that satisfactorily accounts for the variation of cosmic ray intensity with the latitude and altitude.

The proton is the positively charged particle found in the central sun or nucleus of an atom. It has about the weight of the hydrogen atom, the nucleus of which is composed of a single proton, around which revolves a single negatively charged electron. The electron has only 1/1800 the weight of a proton.

The mesotron is the elusive and exceedingly short-lived middleweight particle, with a weight about 1/10 that of the proton. Its life span is only one to two millionths of a second. Consequently many are found high up in the atmosphere, but much fewer lower down. Not many live to reach the earth's surface. During its brief flight, the mesotron parts with most of its energy and degenerates to an electron.

COLOR CHANGES IN ANIMALS

WHEN a chameleon flashes from brown to green in a few seconds, or an eel more sluggishly takes several hours to shift from dark to pallid in skin hue, don't seek the cause for this difference in rates in the nerves of the one animal or the gland secretions of the other. Professor G. H. Parker, of Harvard University, spoke on this subject before the Philadelphia meeting of the American Philosophical Society.

Quickness of color change in some animals, slowness in others is determined primarily by the skin's pigment-containing cells themselves. This is contrary to the zoological doctrine most widely held at present, which states that the quick-changing animals do the trick by means of nerve impulses, while the ones that alter their colors slowly depend on hormones or gland secretions.

This opinion, Dr. Parker said, was based on the examination of only a few animals, and falls down when a score or more species, a wide range of color-changing speeds, are examined. As a matter of fact, the quick-changing chameleon depends on hormones, the slow-changing eel on nerves.

Slowness of response by color cells to either hormone or nerve stimulus has an analogy in a similar slowness in muscle cells. A snail's muscles simply can not move otherwise than very deliberately, while a flea's muscles always contract with a lightning-like snap.—FRANK THONE.

ISLANDS IN THE PACIFIC

TRUK, in the mid-Pacific, is a doomed island. Unless geologic processes now going on in the earth's crust beneath that part of the ocean are stopped or reversed, it will eventually be drowned. The only trouble is that this won't happen in 1943 or 1944—geologic processes are slow.

That Truk is sinking, while other islands that are now enemy strongholds are slowly rising, was pointed out in an address by Professor William Herbert Hobbs, of the University of Michigan, before the meeting of the American Philosophical Society. Professor Hobbs has seen Truk and the other Japanese-mandated islands since they passed under the flag of the Rising Sun. He visited there in 1921, when Japan had just taken over and when our relations with that country were on a much more cordial basis than they have been recently. He was shown many courtesies by the officials in charge, who helped him in the geological studies he was making of the basic geology of the Pacific area.

For geologists interested in the story of mountain-building, most unique opportunities for study are offered by the several curving island chains in the Pacific, from

the Bonins through the Philippines and Indies and far on to the South Pacific archipelagoes and New Zealand. Elsewhere on the earth, whenever a mountain chain has started to grow, it has immediately been attacked by erosion, which cuts it down even as it rises above the general crustal level. These arc-like strings of islands, however, are only the tips of mountain chains now forming as vast upthrust wrinkles from the ocean floor. Erosion therefore plays no part on their long, submerged flanks.

Only on the emersed tips which are the islands have the waves and the weather any chance to do any carving; and this is even a help rather than a hindrance to the geologist. For when an earthquake cycle has boosted the island out of the water another few feet, the waves obligingly carve a notch all around its shores, marking the new level. And if it should sink again, a coral reef forms, indicating the amount of submergence. The island thus serves as a natural measuring-stick for the geological progress of the submarine mountain system of which it is the apex.—FRANK THONE.

INVISIBLE FILM REPELLING WATER

ONE of the most difficult problems faced by radio engineers has been water getting into the porcelain insulators. When that happens, they don't insulate any more, and the set weakens—even stops working altogether. Usual practice has been to treat the insulators with wax; but that is rather impermanent.

Dr. Winton I. Patnode, research chemist of the General Electric Company, has developed a new treatment for these insulators that is said to be about nine times more effective than waxing them, and with permanent results that defy heat, chemical solvents like gasoline, naphtha and carbon tetrachloride, and long exposure to ordinary weather. Objects treated with it simply won't let water wet them. If moisture precipitates on them, it remains rounded up as round droplets, and the wide dry spaces between continue to defy the electricity to pass.

The process is quite simple, but as yet not at all well understood. The objects to be made water-repellent are simply placed in a closed cabinet, and the vapors of one of a group of substances known chemically as the methyl chlor silanes are flooded on them. An after-treatment with ammonia vapor is sometimes desirable, to neutralize corrosive acids that may collect during the moisture-proofing.

Dr. Patnode has been unable to demonstrate the presence of a tangible film on his treated insulators, either with chemical reagents or examination with a high-power microscope. Yet their behavior shows that they are wearing "invisible raincoats."

Numerous other uses are proposed for the new wet-refusing films, most of which must remain undisclosed for the present. One such use, however, promises to make life in the laboratory a lot happier. Everybody has noticed how water rises in a slight curve where the edges of its surface come into contact with the tube or vessel containing it. This curve, called the meniscus, makes it hard to read guages, glass measuring flasks and other laboratory vessels that require highest possible accuracy. If the inside of the glass is given this water-repelling film, the meniscus does not form and the surface is perfectly flat, making readings far easier to take.

ITEMS

OBSERVATIONS on the star-like nucleus of Comet Whipple 2, which was recently visible near the Big Dipper, has led to the discovery of a gaseous compound hitherto unidentified in comets. It is the fragmentary molecule NH_2 produced when hydrogen or methane burns in the flame with nitrous oxide. Although luminous bands of NH_2 have been previously observed in the spectra of other comets, it was their extraordinary strength in Comet Whipple 2 that led to their identification. The observations were made by Dr. R. Minkowski, with the 60-inch reflecting telescope of the Mt. Wilson Observatory. The only other bands in the comet's spectrum besides those of NH_2 that could be identified with certainty were those of the carbon molecule, C_2, which were first described by Swan in the spectrum of the candle flame in 1857. The carbon bands, however, have long been known in comets. Many other bands in Comet Whipple 2 were observed which could not be identified with known gaseous compounds, which serves to emphasize the peculiar conditions that must prevail in the nuclei of comets.

A NEW comet has been discovered by Miss L. Oterma, astronomer of the Turku Observatory, Finland, who is credited with discovering two comets last year. The comet was first seen on April 8 in the constellation of Virgo, which is now easily visible in our evening sky. It is of the fifteenth magnitude and therefore far too faint to be seen without telescopic aid. The new comet is near the celestial equator and moving slowly westward. Harvard Observatory received word of the discovery by way of Denmark and Sweden. On April 8 at 5 P.M., Eastern War Time, the comet's right ascension was 12 hours, 19 minutes, and its declination plus 1 degree, 12 minutes. As comets are named after their discoverer, this will be known as the third Oterma comet.

A STUDY of the little group of stars known as the Pleiades or Seven Sisters has revealed new facts about the nature of the obscuring clouds of interstellar gas throughout our galactic system. The study was carried out by Dr. Walter S. Adams with the 100-inch reflector of the Mt. Wilson Observatory. Nine stars of the Pleiades were selected for observation because their high temperature gave a background against which to detect the dark interstellar clouds. Dr. Adams found that seven of the nine stars show obscuration by both ionized calcium and hydrocarbon gas; whereas two, Asterope and Merope, show obscuration by ionized hydrocarbon only. This is the first case found in which lines of one interstellar gas occur without the presence of ionized calcium. Another interesting point is that neutral hydrocarbon which is prominent in many stars is completely missing from the Pleiades. Dr. Adams concludes that, "The fact that such different interstellar lines are observed in neighboring stars of this small cluster indicates the diversity in the physical conditions of the interstellar clouds and perhaps the limited dimensions which these clouds must have."

SCIENCE

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THE MOBILIZATION OF SCIENCE

IN the Senate of the United States on February 11, Mr. Kilgore introduced the following bill (S. 702), which was read twice and referred to the Committee on Military Affairs:

To mobilize the scientific and technical resources of the Nation, to establish an Office of Scientific and Technical Mobilization, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

DECLARATION OF POLICY

SECTION 1. The Congress hereby recognizes that the full development and application of the Nation's scientific and technical resources are necessary for the effective prosecution of the war and for peacetime progress and prosperity, and that serious impediments thereto consist in—

the unassembled and uncoordinated state of information concerning existing scientific and technical resources;

the lack of an adequate appraisal, and the unplanned and improvident training, development, and use, of scientific and technical personnel, resources, and facilities in relation to the national need;

the consequent delay and ineffectiveness in meeting the urgent scientific and technical problems of the national defense and essential civilian needs;

the trend toward monopolized control of scientific and technical data and other resources with lack of access thereto in the public interest; and

the absence of an effective Federal organization to promote and coordinate, in the national interest, scientific and technical developments.

The purposes of this Act accordingly are—

(1) to appraise the current use of scientific and technical knowledge, facilities, and personnel, and to develop comprehensive national programs for the maximum use of science and technology in the national interest in periods of peace and war;

(2) to mobilize for the prosecution of the war all scientific and technical facilities and personnel;

(3) to facilitate after the war the transition of the national economy from the tasks of war to peacetime enterprise;

(4) to assemble, coordinate, and develop for use, in the public interest, all scientific and technical data and facilities; to facilitate access to scientific and technical information and literature and to aid and encourage the writing and publication thereof;

(5) to promote the full and speedy introduction of the most advanced and effective techniques—for the benefit of agriculture, manufacturing, distribution, transportation, communication, and other phases of productive activity; for economical and efficient Federal, State and local government; and for the national defense and general welfare;

(6) to aid, encourage, and protect the research and enterprise of inventors, scientists, technicians, scientific and educational institutions, research laboratories and Government establishments engaged in scientific and technical work, and to make their resultant discoveries and data more readily available, and without discrimination, to all sections of industry, agriculture, and the public, in order to aid the war effort at the present time and in order to promote full employment and higher standards of living after the war;

(7) to discover and develop substitutes for strategic and critical materials, and to promote the most beneficial use of agricultural, mineral, and other natural resources;

(8) to promote interest in scientific and technical education, and to provide for all qualified persons the means of scientific and technical training and employment;

(9) to provide guidance in scientific and technical matters to the President, the Congress, and all Federal, State, and local government agencies and establishments, and to contribute guidance and, in all proper cases, financial and other assistance to solution of the technical and scientific problems of industry, agriculture, and of any agency or establishment or individual inventor;

(10) to promote the maintenance and expansion of free enterprise by making available to smaller businesses the benefits of scientific advancement;

(11) to standardize, when in the public interest, scientific and technical designs, practices, and specifications; and

(12) to establish a national scientific and technical office to assure maximum cooperation and integration of the facilities and personnel of governmental and private agencies, institutions, and employers for the above purposes, and to coordinate the activity of these facilities and personnel, where necessary, in the national interest. This Act may be cited as the "Science Mobilization Act."

DEFINITIONS

Sec. 2. As used in this Act—

(a) "Scientific and technical facilities" shall include real property and personal property, tangible and intangible, used or intended to be used for scientific or technical purposes, programs, research, projects, and developments and shall include further all methods, processes, procedures, techniques, designs, specifications, patents, inventions, and scientific or technical information or knowledge of every description used or intended to be used for scientific or technical purposes in research and development or in the production or supply of war or civilian goods or services.

(b) "Scientific and technical personnel" shall include all persons, excepting physicians and dentists, who have completed any course of study in any college or university in any branch of science or its practical application or who have had not less than an aggregate of six months' training or employment in any scientific or technical vocation.

(c) "Agency or establishment" shall mean any agency, board, department, office, bureau, or other body of the Federal or any State or local government, or any person, firm, or partnership engaged in business for profit, and any corporation, profit or nonprofit, association, school, college, and university.

ESTABLISHMENT OF INDEPENDENT OFFICE

Sec. 3. (a) There is hereby created, as an independent agency of the Federal Government, the Office of Scientific and Technical Mobilization (hereinafter referred to as "the Office") which shall be administered by an Administrator to be appointed by the President, by and with the advice and consent of the Senate, and to serve at the pleasure of the President. The Administrator shall receive a salary at the rate of $12,000 a year. The Administrator shall appoint, fix the compensation, and define the authority and duties of such officers, employees, attorneys, and agents as he shall deem necessary to carry out the purposes and provisions of this Act and to transact the business of the Office. Such appointments shall be made in accordance with the provisions of the civil-service laws and regulations and the Classification Act of 1923, as amended: *Provided,* That when the Administrator determines it to be necessary in order to effectuate the purposes and provisions of this Act he may waive these requirements. The Office may make such reimbursement as it may deem necessary and proper for the traveling, subsistence, or other expenses incurred in the performance of official duties by its officers, employees, attorneys, agents, and by other persons or members of committees, boards, or other bodies designated by it to carry out such duties. The Office shall be located in or near the District of Columbia, but the Administrator may establish such branch offices outside of the District of Columbia area as may be required to carry out the purposes of the Act.

(b) Any person employed on a full-time basis by the Office shall receive no salary, wages, or other compensation from any source except the Office.

(c) There is hereby established within the Office a National Scientific and Technical Board (hereinafter referred to as the "Board") consisting of the Administrator, who shall be Chairman, and six other members, to be appointed by the President, and to include one representative each for industry, agriculture, labor, the consuming public, and two additional members at large who shall be scientists or technologists. Each such member shall receive compensation at the rate of $10,000 a year. The Board and its several members shall perform such duties under the direction and control of the Adminis-

trator as he may assign to them; they shall have access to all information of the Office relating to the administration thereof.

(d) There is hereby created a National Scientific and Technical Committee consisting of the Board, one representative each for each of such Federal departments as the President shall designate, four additional representatives of the consuming public, three additional scientists or technologists, and six additional members representing labor and six additional members representing management (including small business), in the major fields of production and service to be appointed by the President and to serve without compensation, to advise and consult with the Administrator, who shall be the Chairman thereof, upon the basic policies governing the administration of this Act. Such committee shall meet regularly, not less than once a month.

(e) There is hereby transferred to the Office the powers and personnel of the National Roster of Scientific and Specialized Personnel of the War Manpower Commission, together with its records, furniture, and equipment, and all its unexpended balances of appropriations or other funds available to carry out its powers and duties.

POWERS OF THE OFFICE

SEC. 4. To effectuate the purposes of this Act, the Office shall be vested with the following powers and duties which it shall exercise and perform under the direction and control of the Administrator:

(a) To take and keep a census of scientific and technical facilities, requirements, and personnel in the United States and its possessions and to provide archives for all scientific and technical material coming into the possession of the Government or any agency or department thereof.

(b) To formulate and promote projects and programs for the development and use of scientific and technical facilities and personnel and, when necessary, to initiate and carry out such projects.

(c) To foster and develop scientific and technical methods, to promote their application in the national welfare, either within the Office or by other auspices, public or private, and to promote and provide training and participation in science and in its application.

(d) To ascertain and assess scientific and technical developments in relation to, and to study their impact upon, the national welfare, or any particular category thereof.

(e) To solicit and to receive aid and support from any source for the advancement of scientific and technical methods.

(f) To coordinate the scientific and technical data, methods, and facilities of, or available to, all agencies and departments of the Federal Government.

(g) To foster international cooperation in scientific discovery and the application thereof; to acquire information with respect thereto from other countries and their nationals; to exchange scientific and technical personnel and information with such countries; and to engage in other suitable forms of international collaboration relating to science and technology.

(h) To make available, upon request, to the President, to the Congress, and to other persons or establishments (upon such conditions as the Administrator shall prescribe), technical guidance and assistance and any record or other data necessary therefor.

(i) To review specifications, standards, and designs of military and civilian products and services and their methods of production and supply and to recommend suitable simplifications and changes therein.

(j) To finance by loan, grant, exchange, purchase, or otherwise the operations or functions, or any of them, authorized by this Act, and, for the same purposes, to make or acquire any contract, guaranty, indemnity, stipulation, lease, or other instrument, to acquire, improve, and alter real and personal property, and to enter into any other transaction necessary or appropriate for the performance of its duties or powers.

(k) To acquire patents and patent rights, and to authorize the use thereof, subject to the provisions of section 7 of this Act, and to authorize the use or other disposition of any other property belonging to, or controlled by, the Office, upon such terms and conditions and for such compensation as the Administrator shall determine, which compensation shall be payable to the Office.

(l) To establish a system of merit awards to be granted to any agency, establishment, or person making any outstanding scientific or technical contribution to the national defense or the general welfare.

(m) To make, amend, and rescind appropriate rules and regulations to carry out the purposes of this Act and all the powers and duties vested in the Office, which rules and regulations shall have the force and effect of law.

(n) To avail the Office of the information, services, facilities, officers, and employees of any Federal establishment in carrying out the purposes and provisions of this Act.

(o) To conduct such research and investigation touching upon the use and development of scientific and technical facilities and personnel as the Office may deem necessary and appropriate to carry out the purposes of this Act.

MOBILIZATION OF PERSONNEL

SEC. 5. To mobilize scientific and technical manpower for the prosecution of the war and otherwise to carry out the purposes of this Act—

(a) Section 10 (a) of the Selective Training and Service Act of 1940, as amended, is further amended by adding at the end thereof the following:

"Any provision of this Act to the contrary notwithstanding—

"(1) whenever the Administrator of the Office of Scientific and Technical Mobilization deems it necessary, to carry out the purposes of the Science Mobilization Act, that occupational deferments be granted to persons engaged in any particular scientific or technical occupation or having or receiving any scientific or technical training, he shall certify to the Chairman of the War Manpower Commission that (1) such occupation or training is of a scientific or technical character, and (2) that it is critical in the war effort; and such Chairman shall thereupon approve or disapprove each such certification. In event of such approval, such Administrator shall there-

after determine, subject to such rules, quotas, schedules, and procedures as the Chairman of the War Manpower Commission may prescribe, the facts and circumstances *pertinent to the occupational deferment of any person* within the scope of such certification and whether any such deferment should be made;

"(2) any determination respecting occupational deferment made by the Administrator of the Office of Scientific and Technical Mobilization in accordance with the authority of this section, as amended, shall be conclusive upon all civilian local boards and any other civilian agencies functioning under this Act."

(b) During the existence of a state of war and for six months thereafter, the Administrator is authorized to prescribe and promulgate appropriate rules, regulations, procedures, and methods, subject to direction by the Chairman of the War Manpower Commission, for the training, classification, and employment of all scientific and technical personnel by any person, agency, or establishment, public or private.

MOBILIZATION OF FACILITIES

SEC. 6. To mobilize scientific and technical facilities for the defense of the United States and otherwise to effectuate the purposes of this Act—

(a) (1) During the existence of a state of war, whenever the Administrator determines, subject to review by the President, that (1) the use of any scientific or technical facility, or of any license, easement, privilege, or other right therein, is needed for the defense of the United States or the prosecution of the war; (2) such need is immediate and impending and such as will not admit of delay or adequate fulfillment by resort to any other source of supply; and (3) all other means of obtaining the use of such facility or of any right therein, upon fair and reasonable terms, for the defense of the United States or the prosecution of the war have been exhausted, he is authorized to requisition such facility and any right therein and to dispose of the same in such manner, not inconsistent with this Act, as he may determine to be necessary for the defense of the United States or the prosecution of the war upon the payment of fair and just compensation for such property to be determined in the same manner as provided in Public Law Numbered 274, Seventy-seventh Congress, as amended, except that the Administrator, subject to review by the President, shall make all determinations in the first instance, respecting fair value of such facility and right: *Provided*, That the requisitioning power herein granted shall not extend to any patent itself but shall be confined to licenses or any other right therein respecting user, together with the right to grant sublicenses.

(2) Whenever the Administrator determines that such facility or any right therein requisitioned pursuant to subsection (1) of this section is no longer needed for the defense of the United States or the prosecution of the war, he shall return the same to the person from whom it was requisitioned if such person desires return of the property or facility, in the same manner as provided respecting returns of requisitioned property in sections 1 and 2 of Public Law Numbered 274, Seventy-seventh Congress, as amended, except that no such return shall be required of the Administrator until six months after the termination of the state of war and that any determination of fair value made in connection with such return shall be made by the Administrator in the first instance, subject to review by the President.

(3) The Administrator shall include in his reports directed to be made under section 11 of this Act a separate part with respect to his operations under this subsection.

(b) During the existence of a state of war, the Administrator is authorized to conduct investigations of and concerning the scientific and technical facilities used or capable of use in war or essential civilian production or supply with the view to ascertaining and evaluating the factors affecting efficiency in such production or supply. The Administrator shall submit to the producers and suppliers concerned, and to all appropriate Federal establishments, his recommendations of any improvements disclosed by his investigations to be necessary or desirable for the national defense or the prosecution of the war.

(c) The Administrator is authorized to represent any agency or establishment before the War Production Board or any other appropriate Federal establishment upon any application for allocation of, and priority ratings for, any critical material and equipment for use in scientific and technical research and development. All such applications shall be made only by and through the Office pursuant to appropriate regulations to be prescribed by the Administrator and approved by the Chairman of the War Production Board.

PRODUCTION OF THE PUBLIC INTEREST IN DISCOVERIES AND DEVELOPMENTS FINANCED BY THE UNITED STATES

SEC. 7. (a) Any provision of law to the contrary notwithstanding, the Office is hereby vested with the exclusive right to use, and with the exclusive right to license others to use, (1) any invention, discovery, patent, or patent right which has heretofore resulted, or shall hereafter result, from research or invention for the carrying on of which the United States or any department, agency, or establishment thereof either has heretofore contributed at any time since the declaration of national emergency on May 27, 1941, or shall hereafter contribute, any money, credit, physical facilities, or personnel; and (2) any invention, discovery, patent, or patent right which is at the time of the enactment of this Act, or shall hereafter become, to any extent the property of the United States or of any department, agency, or establishment thereof.

(b) The Office is authorized, subject to such rules and regulations relating thereto as the Administrator may adopt, to grant to any department, agency, or establishment of the United States a nonexclusive license to use any invention, discovery, patent, or patent right which has been vested in the Office by virtue of the provisions of subsection (a) of this section.

(c) The Office is authorized to grant to others than a department, agency, or establishment of the United States a nonexclusive license to use any invention, discovery, patent, or patent right which has been vested in the Office by virtue of the provisions of subsection (a) of this section upon such terms and conditions, including

payment to the Office of a fee or charge for user, as the Administrator may prescribe: *Provided,* (1) That no such license shall be granted unless the Administrator shall first be satisfied and shall find that no monopoly, monopolistic practice, or unfair competitive advantage will be promoted thereby, and (2) that the charge for user prescribed by the Administrator shall either be a uniform nominal fee or a charge graduated to the volume of production resulting from user, or such other scale of charges that shall be necessary or desirable in order to effectuate the purposes of the preceding provisions.

(d) Any owner or assignee of, or any person having an interest in, any invention, discovery, patent, or patent right which has been vested in the Office by virtue of the provisions of subsection (a) of this section shall be paid fair and just compensation for any deprivation of property right resulting from such vesting, to be determined in the same manner as provided in Public Law Numbered 274, Seventy-seventh Congress, as amended, except that the Administrator, subject to review by the President, shall make all determinations in the first instance respecting fair and just compensation: *Provided,* That the Office is also authorized to make suitable compensation, as determined by the Administrator with the approval of the Board, to individual inventors or discoverers or to individuals contributing to inventions or discoveries including employees of the Federal Government, as a reward for their inventions or discoveries or for their contributions thereto when such inventions or discoveries are deemed by the Administrator to be in the national interest and when they are vested in the Office by the provisions of subsection (a) above.

(e) Except as otherwise specifically provided in this Act, neither the Administrator nor any other department, agency, or establishment of the United States shall sell, assign, grant, or otherwise dispose of any invention, discovery, patent, patent right, license, or license right, which has been or shall become vested, acquired, or retained by them or any of them and any transaction or arrangement in violation of this subsection shall be void and of no effect.

(f) The Administrator is hereby authorized and directed (1) to prescribe and promulgate appropriate rules and regulations which shall thereupon have the force and effect of law for the enforcement of the provisions of this section, and (2) to require and incorporate in all licenses, sublicenses, and other instruments and writings made in pursuance of provisions of this Act, such terms and conditions as shall apply the intent and purpose of this section to the facts and circumstances of the particular transaction.

INFORMATION

SEC. 8. (a) It shall be the duty of all persons and establishments, when so requested by or in behalf of the Administrator, to furnish, to the best of their knowledge, any information, data, or record concerning scientific and technical facilities during the existence of a state of war and concerning scientific and technical personnel at all times. Any person or establishment refusing or willfully failing to furnish the same or willfully making any false or fraudulent statement in answer to any such request shall upon conviction thereof, be fined not more than \$5,000 or imprisoned for not more than one year, or both.

(b) The Administrator is hereby directed to maintain the secrecy or restricted character, as the case may be, of any information or data coming into his possession or control under this Act, which is declared to be secret or restricted by other provision of law or the secrecy or restriction of which the Administrator deems otherwise essential to maintain in the public interest. There is hereby established a committee to consist of one member each representing the War Department, the Navy Department, the Office, and any such other Federal establishments as the President may designate which shall advise the Administrator respecting any matter or measure necessary to carry out the purpose of this section.

FUNDS AND FINANCES

SEC. 9. (a) The sum of \$200,000,000 is hereby authorized to be appropriated to carry out the provisions and purposes of this Act. Further sums are authorized to be appropriated as may be necessary and proper for the same purposes. Such sums or any part thereof, together with any moneys realized or received by the Administrator from his exercise of any power granted to him by this Act, may be designated and used at his direction as a revolving fund or otherwise to carry out any power so granted.

(b) Further to effectuate the purposes of this Act, the Administrator is authorized, whenever he deems it necessary and expedient, to create or to organize a corporation or corporations as instrumentalities for the more effective exercise and performance of his own powers and duties or those of the Office, or any part thereof. The Administrator may make loans to, or purchase in whole or in part from time to time, the capital stock of any such corporation for any purpose within the powers of the corporation, and on such terms and conditions as the Administrator may determine: *Provided,* That such capital stock shall be purchased and owned only by the Office.

SUBPENAS AND PENALTIES

SEC. 10. For the purposes of any investigations authorized by this Act, the Administrator and any official designated by him may administer oaths and affirmations, subpena witnesses, take evidence, and require the production of books, papers, and other documents which the Administrator or such officer deems to be relevant or material to the inquiry. Such attendance of witnesses and the production of such documentary evidence may be required from any place in the United States or any Territory or possession thereof at any designated place of hearing. In cases of contumacy by, or refusal to obey a subpena served upon any person, the district court for any district in which such person is found, resides, or transacts business, upon application by or on behalf of the Administrator, shall have jurisdiction to issue an order requiring such person to appear and give testimony or to appear and produce documents, or both; and any failure to obey such order of the court may be punished as a contempt thereof. Witnesses subpenaed under this section shall be paid the same fees and mileage as are paid witnesses in

the district courts of the United States. No person shall be excused from complying with any requirements under this section because of his privilege against self-incrimination, and the immunity provisions of the Compulsory Testimony Act of February 11, 1893 (U. S. C., 1934 edition, title 49, sec. 46), shall apply with respect to any individual who specifically claims such privilege. Any person who willfully violates any order, rule or regulation promulgated by the Administrator under the authority of this Act, shall, upon conviction thereof, be fined not more than $5,000 or imprisoned for not more than one year, or both.

PERIODIC REPORTS

SEC. 11. The Administrator shall render a report in writing to the President and to the Congress in January of each year summarizing the activities of the Office in the calendar year just ended and reporting on the status and progress of science and on scientific and technical problems affecting the public interest together with such recommendations as he may deem appropriate within the purposes of this Act. During a state of war, he shall make interim reports quarterly during each of the months of January, April, July, and October.

SEVERABILITY CLAUSE

SEC. 12. If any clause, sentence, paragraph, or part of this Act shall be adjudged by any court of competent jurisdiction to be invalid, such judgment shall not affect, impair, or invalidate the remainder thereof but shall be confined in its operations to the clause, sentence, paragraph, or part thereof directly involved in the controversy in which such judgment shall have been rendered.

SOME OBSTACLES IN THE PATH TOWARDS AN OPTIMUM DIET. II

By Dr. A. J. CARLSON

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(G) *Poverty*. Many people are undoubtedly inclined to put poverty as obstacle No. 1, even on the road to a good or adequate diet not to say an optimum diet, and I am not quarreling with the relative importance of any of the factors, as I indicated in the beginning. Whatever the percentage of truth there is in the view that forty million, even a hundred million, Americans are badly nourished, there can be no doubt that financial handicaps may be serious enough to prevent the purchase and consumption of food adequate for good health. And even if only one per cent. of our fellow citizens belong in this category in this land of abundance of good foods, that would be a reflection on our wisdom and our competence. But among men, as among animals below man, securing food without labor, without scratching leads in the long run to deterioration.

Among the wants and fears of man in many lands are the lack of good foods and the fear of starvation. Sir John B. Orr, the British war-time food administrator, has recently proposed that this seemingly simple aspect of the "Atlantic Charter" should be our primary concern. But even this is by no means simple. For in absence of epidemics, all species, man included, tend to reproduce beyond the limits of an adequate food supply for all. So a necessary corollary to freedom from the want of good food, and freedom from the fear of starvation everywhere, is planned parenthood. To me at least, this seems as humane, reasonable and necessary as our civilized and scientific endeavors to prevent and control the other form of universal human suffering—disease.

The financially poor, the financially unfortunate appear to have been with us throughout recorded history. The common saying is: "The poor will always be with us." Maybe so, at least in a relative sense. For there is also poverty in foresight and poverty in individual endeavor. In so far as this is due to poverty in heredity, common sense seems to say that, as knowledge grows, we must apply new measures to decrease the production of chicks that chirp but can not or will not scratch. Unless reason based on understanding effectively guides social evolution of tomorrow in that direction, I see no escape from the degeneration that invariably follows biologic parasitism, except the ancient "law of tooth and claw." The killing of millions of pigs for fertilizer, and restricting the production of such important foods as wheat and corn, all by Federal regulation, do not (in my judgment) square with our concern for an optimum diet of man (the poor included), even in our own land.

(H) *Appetite*. We know to-day very much less about the precise mechanism of appetite for food than we know about the mechanism of hunger, but stated briefly, appetite for food in contrast to hunger does not seem to be primarily inherited. It seems to be a memory of previous pleasant experiences with foods, pleasant experiences in the sense of taste, odor and visual appearance of foods. One fact stands out clearly in the matter of appetite, and that is this: All normal people seem to be able to acquire a liking or appetite for any kind of substance that can serve the nutrition of man. This, I think, is a factor of safety as well as a factor of danger for the human dietary.

The factor of safety appears in the human capacity for omnivorousness, that is, consumption of a great variety of foods. The dislike for or actual revulsion to a monotonous diet is a drive towards variety, if not omnivorousness in foods. There is no doubt that this tendency or habit of omnivorousness will in part explain the dietary success of our forebears and of wild animals, in the absence of specific understanding of food requirements. On the other hand, there is danger in combining the products of human ingenuity in the matter of food processing and food preparation with the capacity to develop liking for foods that are so defective in essential elements that when they are made a preponderant part of our diet, we may develop serious malnutrition. Three of such common foods to-day are the refined sugars, polished rice and bread made out of our modern patent flour. These are good foods. We can, and we have developed appetite for them, but because of refinement, they are so defective in many essential dietary elements that they can lead, in fact they have led, to nutritional disaster when they make up too large an element in our overall food consumption. I think it is particularly important to recognize the safety in dietary omnivorousness, to recognize the fact that we can and should develop liking for, that is appetite for, a great variety of foods as soon as feeding at the breast or by bottle is supplemented by the common foods of man, because these likings or appetites are probably most easily established in the early years of life. When good food is abundant the gray squirrel eats the germ in the grain of corn and discards the rest. We eat the rest and discard the germ. The pregnant and lactating squirrel (a herbivore) eats bones, when she can get them. So do cattle (other herbivores) ranging on land poor in lime. We do not know when or how these primitive appetites were lost to or suppressed in man.

The vagaries of appetite may lead to malnutrition in two directions. It may lead to eating too little (anorexia nervosa) or eating too much. The chronic and serious depression of appetite usually has a psychological basis both in children and in adults; in fact it may follow a period of such great appetite that the person is eating to marked obesity. The criticisms and the ridicule of this obesity by the obese person's friends and associates may ultimately bring on such a mental state that for weeks, months and years, the eating of the very best of foods leads to vomiting. Fortunately these cases are not numerous, but obviously the cure here is neither more money, more food or better education as to foods. Perhaps the most serious aspect of the vagaries of appetite as an obstacle on the path towards optimum nutrition is that condition where the pleasures at the table so dominate in the individual's life that eating to the point of obesity follows. To be sure obesity may parallel an incipient malnutrition of factors other than calories in the diet, but I repeat, in the experimental animals at least, chronic deficiency in any one essential dietary factor impairs or retards both growth and weight. Since obesity is more than twice as prevalent in the American population as is underweight of equal degree, maybe we should give more attention than we have up to date to this aspect of malnutrition because, depending on the degree of obesity, this condition is a strain on the body reserves, renders man less fit for many tasks, and shortens his life span.

(I) *Chronic alcoholism.* As a food alcohol is among the most defective and most expensive of our foods. Curiously, alcohol in moderation is not infrequently taken before or with the meals with the avowed purpose of easing or aiding appetite and digestion. No animal below man seems to need this stimulus, although it is proven that moderate amount of alcohol does increase the secretion of gastric juice whether or not we need that increased amount of gastric juice. It is well known that alcohol, acting both on the alimentary canal and possibly also on the central nervous system, may induce temporary nausea, vomiting, anorexia and intolerance for foods. This is not a serious aspect when we think in terms of malnutrition. This comes in only in the case of those people who indulge in alcohol to excess and so constantly that consumption of food for adequate health is impaired, presumably by impairment of brain function, although action of chronic alcoholism in this direction on the alimentary canal and other organs of the body can not be excluded. Obviously the cure of this form of malnutrition lies neither in supplying more or better food or more cash for the latter would be likely spent for more alcohol. This malnutrition is obviously secondary to chronic alcoholism and this in turn may stem from hereditary as well as social forces that so far as we know to-day do not spring from any form of malnutrition.

(J) *Myopic federal state laws and regulations limiting free production, transportation and sale of good foods.* A writer has called these federal and state laws and regulations "state barriers for starvation." I have before me a list of these federal and state penalties on good foods. There is a federal tax of ten cents per pound on colored margarine. This effectively prohibits the sale of this margarine in the United States. The experience in Europe and in the United States goes to show that margarines palatable and of a nutritious value, in all probability not inferior to good butter, can be made out of vegetable fats or animal fats other than that in milk. Such margarines can and usually are fortified by the ad-

dition of the vitamins present in milk fats. We usually add a non-toxic color to winter butter without either labeling or taxing it, but when this color is added to margarines our federal government taxes it at ten cents per pound. Ostensibly this law was enacted for the protection of the consumer against deception. That phase can be taken care of by labeling, for most Americans can read. Actually the law was forced on our country by a pressure group, and I fail to see where the law works in the interest of our fellow-citizens in the lowest income group. Were all federal and state restrictions on good margarines swept overboard good margarine could probably be made and sold at half the cost of good butter. It appears that thirty states have themselves absolute prohibition against the sale of colored margarine. Twenty-nine states prohibit the importation of so-called "filled milk." This food is a combination of skimmed milk and animal or vegetable fats other than butter fat. This food, like margarine, can be and usually is fortified with the vitamins found in good condensed milk. Northern dairy states discriminate against margarine and "filled milk." Southern states retaliate by restricting dairy food from the northern states. It appears that several states recently have forced higher prices on dairy food by requiring inspection at the source of supply by officials of the importing state, an inspection duplicating that of the producing state. While these laws and regulations, state and federal, are dictated by selfish interests rather than the dietary welfare of the nation as a whole, they probably do not play a large role in the malnutrition existing in our country in terms of number of people, except among the poor. But it should also be said that any remedial measure tending to promote a good diet even for the poorest of our citizens should not be overlooked in our overall program for national nutritional welfare.

(K) *Wishful thinking or worse.* Even at the risk of concluding this discussion on "a sour note" I designate the last "obstacle" wishful thinking or worse. We, the laborers in science, must examine our moorings, lest mirages and miracles replace proven reality, and we too become the blind leaders of the blind. I know as yet of no dietary factor automatically assuring even in a man of science the rule of reason every day.

A high-ranking Government official in Washington said recently: "Defective stamina, intelligence, judgment, will, stability, can be treated by doses of synthetic vitamins." Since this administrator is neither a chemist, biologist nor physician, the information on which this extraordinary assertion is made must have been supplied by some one of our scientific colleagues, on whom rests the primary responsibility. Treated? Yes. These and other human impairments have had their therapies by the thousands. We all can "call the spirits from the vasty deep." But, do they come when we call them? If treated means treated with proved success, then it seems that a fractional potential has been turned into a universal affirmative. A cautious working hypothesis, such as the following—"deficient diets, short of producing a full-blown deficiency disease, may be responsible for such vague symptoms as mental depression, indigestion, easy fatigue, loss of weight, retarded learning ability and impaired vision"—is turned a proven fact, without further evidence. The administrator supports his statement with the following tale: "Recently I was told that a western trucking company had actually achieved a reduction of its night accident rate by providing all its drivers with bags of raw carrots at the beginning of each trip." We are not told what the truck drivers did with those bags of carrots. Did they hang them around their necks, or did they chew and swallow them? Or was this little item not checked? If they chewed the carrots, somebody who knows should have told those concerned that chewing carrots or chewing the rag are aids to keeping awake, no matter what either may do for the rhodopsin of the retina in the way of better vision in faint light. I know of no statistics showing what factor drowsiness, apart from poor vision (night blindness), plays in the safe operation of trucks at night. Some years ago a New York physician reported improvement in the scholastic record of New York City's backward children by feeding them extracts of the pineal gland. That "promising" therapy seems to have passed on. Now, vitamin pills perform these miracles, apparently even when heredity has been niggardly, and accidents and disease have left their marks on the unfortunate individual.

We are told by a colleague in chemistry: "It is recognized already that one vitamin can and does cure mental derangements." This is stated without qualifications, while as a matter of fact mental derangements are due to a great diversity of factors, including heredity, mechanical and chemical trauma and cerebral ischemia. The value of the vitamin B complex in mental derangements seems to be largely limited to those accompanying advanced pellagra and chronic alcoholism. The 1942 faith and hope in universal health miracles from synthetic vitamin pills seem premature, if not immature. When I see our institutions for the feeble-minded and the insane evacuated and closed by giving any or all of our 1942 variety of vitamin pills to these unfortunate fellow citizens I, too, will sing "Hosanna to the Highest." This scientist goes on to say: "Good diets, which mean an abundant supply of vitamins, promote in-

tellectual keenness. . . . There can be no doubt that much dullness on the part of school children . . . can be traced in part to lack of the proper kind of food and especially lack of enough vitamins." These are broad and important generalizations. But I know of no evidence that an ample ingestion of vitamin pills will materially improve the scholastic record of the millions of children and young adults in our schools. These assertions are just too good to be true. Human biology is not that simple.

Another colleague in chemistry tells us that the Germans "have enjoyed a more generous supply of thiamin and other vitamins which grains provide than have Scandinavia, the Low Countries, France, Spain, Italy or the British Isles. Perhaps pacifism is a product of malnutrition." Yes, the god "Mars" is traditionally pictured as a well-nourished specimen, and if good nutrition leads to war, and malnutrition to the striving for peace, what kind of diet has enabled man to discover the scientific method, to develop a sense of justice, a spirit of fair play, a love, respect and preference for truth and individual honesty? Are modern science and modern education sequelae of malnutrition?

Recently a subcommittee on medical nutrition of the National Research Council presented a report on malnutrition, under the heading, "Recognition of Early Nutritional Failure," and with two tables of signs and symptoms. I fully agree with this committee when it says: ". . . there is imperative need for (a) determination of the actual incidence of early deficiencies among the general population and for (b) the establishment of satisfactory diagnostic criteria for the recognition of such conditions." But after tabulating no less than twenty-nine alleged signs and symptoms of early or incipient dietary deficiencies that even laymen might observe and diagnose, the committee seems to wipe out its entire tabulation and report by this statement: "Implicit in the definition of the problem and in the foregoing statements is the fact that no symptoms or physical signs can be accepted as diagnostic of early nutritional failure. Certain symptoms and physical signs, however, when verified by a competent physician and when other possible causes have been ruled out, should be considered as significant indications." If this latter statement is true, and I subscribe to it, their tabulation is misleading, if not false *in toto,* in so far as present known facts of incipient dietary deficiencies are concerned.

The committee lists lack of appetite as a sign of incipient malnutrition. This is contrary to my experience, both in man and in animals. I saw hundreds of thousands of undernourished people on the continent of Europe in the winter of 1919, but, unless moribund, these people were eager for good foods. They eat the most unappetizing foods. At the end of over forty days of complete starvation a person, otherwise normal, has an appetite for food keener than at the start of the fast. I have had dogs, for various research purposes, fast much longer than forty days. At the end, or towards the end of these long fasts, these dogs grab food eagerly. To be sure, the rat on a diet deficient in the vitamin B complex will after a while eat less and less of this ration. But it will, unless moribund, eat a better ration. So appetite is not lacking. But it is clear that appetite for food being impaired by any cause will ultimately lead to malnutrition.

The alarming claim (100,000,000 Americans do not have a good diet) for national malnutrition in our land appears to be based primarily upon a series of surveys conducted by the Bureau of Home Economics of our Federal Department of Agriculture. These surveys embraced some 4,000 urban and village families of various levels of income and some 2,000 rural families of varying levels of income, selected from representative regions of our country. The surveys consist in reports from these families as to how much money they spent for food and what kinds of food were bought and, in the case of rural families, how much and what kind of food they consumed from the crops on their own farms. These field investigators had to take or did take the people's word for all these alleged facts. It is impossible to determine the degree of accuracy as to memory of whatever member of these families gave the facts or alleged facts to the enumerators. The precarious character of such data should have been apparent to any scientist who is free to work and think.

On the basis of the kind and quantity of the food bought or grown on the farms, the Bureau of Home Economics estimated the diets of these families as excellent, good, fair or poor. No physical or medical examination was made of the members of these families. Not even such a simple physical fact as the determination of the body weights of the people involved seems to have been undertaken. The necessity of such checks should also have been evident. The value of these statistics must largely be left up in the air as regards evidence for good or bad nutrition in our country by neglecting such an obvious factor as medical evidence of the health status of the people concerned, even though examination would have disclosed only advanced malnutrition.

How does Dr. Parran's interpretation of these statistical studies by the U. S. Bureau of Home Economics check with data from other sources? Hospital

statistics (admission, mortality rate) do not reveal significant national malnutrition in the United States, except for pellagra in the South. Of course, the mortality statistics reveal only terminal malnutrition, and admission statistics tell us only of malnutrition recognizable by present tests. Chronic malnutrition shortens the life span, but last year the average length of life of our citizens reached an all-time high or 63.42 years. There is some statistical evidence that our children are growing faster and taller than in the past, that college freshmen are taller than a decade or more ago. Children and youths do not grow faster or taller on inadequate diets. But we admit freely that these statistics do not cover our entire population. They are, however, indices. Malnutrition on a national scale does not lead to obesity, quite the reverse. This is certainly true of the experimental animal. And that was my observation in the war-devastated countries in Europe at the conclusion of World War I. Recent studies by the Life Extension Examiners show that 10 per cent. or more overweight is nearly three times more prevalent (28 per cent.) in the United States than 10 per cent. or more underweight (12.8 per cent.). It is a curious coincidence that the percentage of obesity in our people should come so close to Dr. Parran's estimate of the people having a good diet (25 per cent.). The obese may enjoy a good diet, but they do not use it wisely. Apart from pellagra, perhaps obesity is the most serious aspect of malnutrition in our country.

If 100,000,000 Americans, in times of peace and food plethora, had poor diets, that should have been revealed on medical examination of our millions of young men for our Army and Navy. All these data are not yet assembled and analyzed, but according to Dr. Rowntree, the first 800,000 men, age 21 to 35, examined in the 1941 U. S. Army draft had an average height of 67.5 inches, or exactly the same average height as our drafted men in World War I. But the 1941 men were on the average eight pounds heavier than the Army men of 1917–1918. We do not know whether these eight pounds represent muscle, bone or fat. These data on the 1941 draftees do not point towards an overwhelming malnutrition in our country. This should give us some assurance and some happiness. But we should not be content, we should not rest on the oar until we have discovered more adequate tests of incipient malnutrition; until we have cleared our land of myopic food practices; until we see dawn of understanding dispelling our fog of ignorance as to the nature of health and the nature and role of foods; until we have reached first base, at least, in driving pellagra from our homes. We have sufficient knowledge both as to causes, prevention and the cure of pellagra. We have the food to do it. And yet we have made scarcely a dent on this national disgrace. No, my fellow citizens, the day of rest and contentment for the students of human health is out of sight in war, and will not be in sight with peace. For this road is long, tortuous and difficult.

SCIENTIFIC EVENTS

RESOLUTIONS PASSED BY THE HOSPITAL BUREAU OF STANDARDS AND SUPPLIES

THE resolutions given below were passed at the annual meeting of the Hospital Bureau of Standards and Supplies held in New York City on February 25, at the conclusion of the address on "Hospitals and the War Program," by Maury Maverick, chief of the Bureau of Governmental Requirements of the War Production Board, Washington, D. C.

RESOLUTION I

WHEREAS, all resources of the nation should be used to the best advantage toward a successful and efficient prosecution of the war, and

WHEREAS, this nation must be prepared to provide full and complete hospital care and rehabilitation of the wounded of the services as well as for civilians, and

WHEREAS, the fullest possible utilization of existing government and civilian hospitals is desirable for the purpose of conserving manpower and critical materials,

Be it Resolved, therefore, by this organization that the President of the United States be requested to appoint a commission to study the problem of the most efficient use of the country's hospitals in connection with the war, this commission to consist of representatives active in the management of voluntary, public and governmental hospitals and national health agencies, with authority to secure adequate professional assistance to advise the commission in regard to technical matters arising in connection with the study, and

Be it Further Resolved, that this commission be authorized to make a comprehensive report with such recommendations as may appear to it to be wise, and

Be it Resolved, that this commission be also authorized to investigate other problems affecting hospitals in connection with the war, such as construction, personnel shortages, food rationing and shortages of materials and equipment, to the end that the people of the nation, both in military service and in civilian life, may be afforded adequate hospitalization facilities and services to protect the health of the nation.

This resolution was endorsed at the meeting of the Greater New York Hospital Conference on February 26. It is now being referred to James A. Hamilton, president of the American Hospital Association, for

such action as his organization deems proper to take in connection with it.

RESOLUTION II

WHEREAS, there is now a wide diversification in sizes, styles and qualities of many categories of hospital supplies and equipment,

WHEREAS, this diversification results in less efficient production methods, more man hours per unit and wastage in the utilization of materials in the manufacture of the product,

WHEREAS, the purchase and use of supplies and equipment in a wide variety of styles, sizes and qualities results in inefficient utilization in institutions and a loss in effective purchasing methods,

WHEREAS, such reduction in efficiency in the production and consumption of this material should not be tolerated during the war period,

Be it Resolved, therefore, that the Hospital Bureau of Standards and Supplies promote in every way possible and assist all government agencies working on the problem of the simplification and standardization of hospital goods to the end that wastage of materials and man hours be reduced as far as possible.

THE MERCK INSTITUTE FOR THERAPEUTIC RESEARCH

ACCORDING to information received from Merck and Co., Inc., the tenth anniversary of the opening of the Merck Institute for Therapeutic Research was celebrated with appropriate ceremonies on April 26. Following the exercises a dinner was held at the Essex House in Newark. George W. Merck, president of Merck and Co., Inc., presided and introduced the speakers.

Among these were Dr. William H. Sebrell, chief of the division of chemotherapy of the National Institute of Health and assistant director of nutrition for the Defense, Health and Welfare Services in Washington; Dr. Francis G. Blake, dean of the Yale Medical School and chairman of the Subcommittee on Infectious Diseases of the National Research Council; and Dr. Russell M. Wilder, professor of medicine, the Mayo Clinic.

Messages of congratulation were received from Sir Henry Dale, president of the Royal Society, London, and Dr. Alfred N. Richards, vice-president in charge of medical affairs of the University of Pennsylvania Medical School and chairman of the Committee on Medical Research of the Office of Scientific Research and Development, Washington.

The Merck Institute for Therapeutic Research, a non-profit corporation under the laws of the State of New Jersey, was founded in 1933 for the purpose of conducting investigations into the causes, nature and mode of prevention and cure of diseases in men and animals. The determination of the therapeutic value and safety of new drugs is one of its principal duties.

During the afternoon ceremonies in the institute building, the tenth annual report was presented by the director, Dr. Hans Molitor. Dr. Molitor pointed out that, since 1933, the size of the Merck Institute has increased almost six times, and its personnel eighteen times. The new three-story laboratory building, which is completely air-conditioned and equipped with up-to-date facilities, was occupied two years ago. Vitamins and chemotherapy are the principal fields of research. Since the outbreak of the war, only problems of immediate importance to the war effort have been permitted to remain on the research program. Notable among these are penicillin and new antimalarial products.

THE COPERNICAN QUADRICENTENNIAL CELEBRATION

DR. STEPHEN P. MIZWA, director of the Kosciuszko Foundation and secretary of the Copernican Quadricentennial National Committee, is arranging for a national scientific tribute to Nicholas Copernicus. This will take place in Carnegie Hall, New York, on Monday evening, May 24. Reservations for boxes and tickets are now available at the headquarters of the Kosciuszko Foundation, 149 East 67th Street, New York.

Dr. Harlow Shapley, professor of astronomy and director of the Harvard College Observatory, chairman of the Copernican Quadricentennial National Committee, will preside. He will be introduced by Dr. Henry Noble MacCracken, president of Vassar College, and also president of the Kosciuszko Foundation since its organization in 1925 for the promotion of intellectual and cultural relations between the people of Poland and the United States.

In announcing the program of events for the Carnegie Hall meeting Dr. Mizwa said: "Nicholas Copernicus, the famous Polish astronomer of the sixteenth century, is internationally recognized as one of the world's great intellectual pioneers. His revelation of the heliocentric, or Copernican, system of astronomy in his epoch-making treatise, 'De Revolutionibus Orbium Coelestium,' published in 1543, revolutionized man's outlook upon the universe and introduced the era of modern science."

An international broadcast from London is planned with greetings from Sir Henry Hallett Dale, president of the Royal Society. His Excellency Jan Ciechanowski, ambassador of Poland at Washington, will present a message from the president of the Republic of Poland. Brief scientific addresses will be delivered by Dr. Joel Stebbins, president of the American Astronomical Society, professor of astronomy at the University of Wisconsin and director of Washburn Observatory; the Reverend Father Michael J. Ahern, S.J., senior professor of science at Weston College,

Massachusetts; Dr. Oscar Haleski, formerly professor of history at the University of Warsaw, at present director of the Polish Institute of Arts and Sciences in New York, and Dr. Edward Rosen, Copernican scholar and instructor in history at the College of the City of New York.

Musical features will include the traditional Polish "Hejnal" or "The Broken Note Signal," dating from the legendary trumpeter of Krakow in the thirteenth century, whose warning saved the city from the Tartar invasion; the national anthems of the United States and Poland, and the Gaude Mater Polonia, Alma Mater song of the University of Krakow, sung by the Schola Cantorum of New York, and solo selections by Wanda Landowska, Polish harpsichordist, and by Bronislaw Huberman, Polish violinist.

THE AMERICAN PHILOSOPHICAL SOCIETY

AT the annual general meeting of the American Philosophical Society, held in the hall of the society at Independence Square, Philadelphia, on April 22, 23 and 24, the following officers were elected:

President, Edwin G. Conklin.

Vice-presidents, Frederick P. Keppel, Edward P. Cheyney, Thomas H. Morgan.

Secretaries, W. F. G. Swann, Ernest M. Patterson.

Curator, John Story Jenks.

Treasurer, Fidelity-Philadelphia Trust Company.

Councillors, Arthur B. Coble, *Class I;* Herbert S. Gasser, *Class II;* Edmund E. Day, *Class III,* and Frank Aydelotte, *Class IV.*

The following twenty-seven resident and five foreign residents were elected:

MATHEMATICAL AND PHYSICAL SCIENCES

Raymond Thayer Birge, professor of physics, University of California

Samuel Colville Lind, dean, Institute of Technology, University of Minnesota

Donald Howard Menzel, associate professor of astrophysics, Harvard University

Marshall Harvey Stone, professor of mathematics, Harvard University

Merle Antony Tuve, chief physicist, Department of Terrestrial Magnetism, Carnegie Institution of Washington

Frank Clifford Whitmore, dean, School of Chemistry and Physics, Pennsylvania State College

Foreign

Sir William Lawrence Bragg, Cavendish professor of experimental physics, University of Cambridge

Luitzen Egbertus Jan v. Brouwer, professor of mathematics, University of Amsterdam

Godofredo García Díaz, professor in the faculty of sciences of the University of San Marcos, Lima

GEOLOGICAL AND BIOLOGICAL SCIENCES

Rollin Thomas Chamberlin, professor of geology, University of Chicago

Ralph Works Chaney, professor of paleontology and chairman of the department of paleontology, University of California

Hans Thacher Clarke, professor of biochemistry, Columbia University

Leslie Clarence Dunn, professor of zoology, Columbia University

Ernest William Goodpasture, professor of pathology, Vanderbilt University

Warren Harmon Lewis, member, Wistar Institute of Anatomy and Biology

George Linius Streeter, director, department of embryology, Carnegie Institution of Washington (retired)

SOCIAL SCIENCES

Julian Parks Boyd, librarian, Princeton University

Douglas Southall Freeman, editor, *Richmond News-Leader*

Owen Lattimore, lecturer, director, Walter Hines Page School of International Relations, the Johns Hopkins University

Henry Allen Moe, secretary-general, Guggenheim Memorial Foundation

Walter W. Stewart, professor, School of Economics and Politics, Institute for Advanced Study, Princeton, N. J.

Quincy Wright, professor of international law, University of Chicago

HUMANITIES

William Ernest Hocking, Alford professor of philosophy, Harvard University

Fiske Kimball, director, Philadelphia Museum of Art

Charles Grosvenor Osgood, professor emeritus of English, Princeton University

Erwin Panofsky, professor of the history of art, Institute for Advanced Study, Princeton, N. J.

Mary Hamilton Swindler, professor of classical archeology, Bryn Mawr College

George Clapp Vaillant, director, University Museum, University of Pennsylvania

Foreign

John Davidson Beazley, professor of classical archeology, University of Oxford

Alan Henderson Gardiner, editor, *Journal of Egyptian Archeology,* London

COUNCIL NOMINEES

Chester Irving Barnard, president, New Jersey Bell Telephone Company

Henry Agard Wallace, Vice-president of the United States

THE NATIONAL ACADEMY OF SCIENCES

ELECTIONS at the spring meeting of the National Academy of Sciences, held in Washington on April 26 and 27, are:

President, Dr. Frank B. Jewett, New York City, reelected for a further term of four years, ending June 30, 1947.

Home Secretary, Dr. F. E. Wright, 2134 Wyoming Avenue, Washington, D. C., reelected for a further term of four years, ending June 30, 1947.

Members of the Council (terms, three years ending June 30, 1946), W. Mansfield Clark, Johns Hopkins

Medical School, Baltimore (reelected); Walter R. Miles, Yale University School of Medicine (succeeding Oswald Veblen).

New Foreign Associates:

- Alfonso Caso, Instituto Nacional de Antropologia e Historia, Mexico City
- Harold Spencer Jones, Royal Observatory, Greenwich, England
- Richard Vynne Southwell, Brasenose College, University of Oxford
- Charles Edward Spearman, University of London
- Sir D'Arcy Wentworth Thompson, University of St. Andrews
- Hendrik Johannes van der Bijl, University of Pretoria, South Africa

New Members:

- Leason Heberling Adams, Geophysical Laboratory, Carnegie Institution of Washington
- Abraham Adrian Albert, University of Chicago
- Jesse Wakefield Beams, University of Virginia
- Arthur Francis Buddington, Princeton University
- Leonard Carmichael, Tufts College, Medford, Mass.
- William Henry Chandler, University of California at Los Angeles
- Edwin Joseph Cohn, Harvard Medical School
- John Nathaniel Couch, University of North Carolina
- Theodosius Dobzhansky, Columbia University
- Lee Alvin DuBridge, University of Rochester
- Leslie Clarence Dunn, Columbia University
- Wallace Osgood Fenn, University of Rochester
- Paul Darwin Foote, Gulf Research and Development Company, Pittsburgh, Pa.
- Louis Plack Hammett, Columbia University
- William Vermillion Houston, California Institute of Technology, Pasadena
- Walter Pearson Kelley, Citrus Experiment Station, Riverside, Calif.
- Warfield Theobald Longcope, the Johns Hopkins University
- Eli Kennerly Marshall, Jr., the Johns Hopkins Medical School
- Leonor Michaelis, Rockefeller Institute for Medical Research, New York City
- William Albert Noyes, Jr., University of Rochester
- Oswald Hope Robertson, University of Chicago
- Carl-Gustaf Arvid Rossby, University of Chicago
- Calvin Perry Stone, Stanford University
- Charles Vincent Taylor, Stanford University
- Hubert Bradford Vickery, Connecticut Agricultural Experiment Station, New Haven
- Vladimir Kosma Zworykin, RCA Manufacturing Company, Camden, N. J.

RECENT DEATHS

DR. H. GIDEON WELLS, professor emeritus of pathology of the University of Chicago, died on April 26 at the age of sixty-seven years.

DR. GEORGE MCPHAIL SMITH, professor of inorganic chemistry at the University of Washington, died on April 6 at the age of sixty-four years.

DR. LOUIS AGASSIZ TEST, until his retirement in 1941 for twenty-three years professor of chemistry at Purdue University, died on April 23. He was sixty-eight years old.

DR. ALBERT P. BRUBAKER, professor of physiology and medical jurisprudence at Jefferson Medical College, Philadelphia, from 1909 to 1927, a member of the faculty for fifty-three years, died on April 29 at the age of ninety years.

SCIENTIFIC NOTES AND NEWS

THE Theobald Smith Award of $1,000 and a bronze medal of the American Association for the Advancement of Science, established by Eli Lilly and Company in 1935, has been given to Dr. Sidney C. Madden, assistant professor of pathology at the School of Medicine and Dentistry of the University of Rochester, in recognition of his work on "Plasma Proteins."

THE Civic Medal, awarded annually by the Rochester Museum Association, will be presented on May 13 to Dr. George H. Whipple, dean of the School of Medicine and Dentistry of the University of Rochester.

THE Board of Directors of the Sociedad de Agricultores de Colombia has named the following as corresponding members: Dr. Alexander Wetmore, assistant secretary, Smithsonian Institution; Dr. Edward A. Chapin, curator of insects, U. S. National Museum; Dr. Ellsworth P. Killip, associate curator, Division of Plants, U. S. National Museum; Dr. C. P. Clausen, principal entomologist, in charge of Importation of Natural Enemies used to Control Insect Pests, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture; Dr. H. Atherton Lee, director, Insular Experiment Station, Mayagüez, Puerto Rico.

ALFRED C. WEED, for the past twenty-two years curator of fishes at Field Museum of Natural History, Chicago, retired on April 30. A farewell reception was held in his honor by fellow workers, who presented him with bound volumes of his writings in both the scientific and popular fields.

THE Executive Committee of the American Society of Zoologists, by mail ballot, have elected the following officers proposed by the nominating committee: *President,* Professor T. S. Painter, University of Texas; *Vice-president,* Professor L. H. Snyder, the Ohio State University; *Secretary,* Dr. L. V. Domm,

the University of Chicago, three years; *Member of the Executive Committee,* Professor L. L. Woodruff, Yale University, five years.

AT the business meeting on April 14 of the Illinois Institute of Technology Chapter of the Society of the Sigma Xi, the following officers were elected for the coming year: *President,* Dr. Paul L. Copeland, professor of physics; *Vice-president,* Dr. Max Jacob, research professor of mechanical engineering; *Secretary,* Dr. Hugh J. McDonald, assistant professor of chemistry; *Treasurer,* Dr. Leslie R. Hedrick, associate professor of biology. Dr. Henry Eyring, professor of chemistry at Princeton University, addressed the chapter on "The Drift Toward Equilibrium."

DR. O. S. MORGAN, professor of agriculture at Columbia University and head of the department, and E. B. Phelps, professor of sanitary science, a member of the faculty of the College of Physicians and Surgeons, will retire at the close of the academic year.

DR. WILLIAM T. MARTIN, of the Massachusetts Institute of Technology, has been appointed head of the department of mathematics at Syracuse University.

DR. RALPH E. WHEELER, assistant professor of preventive medicine and public health at Vanderbilt University School of Medicine, has been appointed to the newly established professorship of bacteriology of the Medical School of Tufts College.

IT is stated in *Nature* that Professor W. M. Macmillan, who has been working for the past two years in the Empire Intelligence Section of the British Broadcasting Corporation, has been selected by the British Council to act as its representative in West Africa. He will leave for the West Coast as soon as possible. His appointment follows a survey recently made by C. A. F. Dundas, the British Council's representative in the Middle East. It is hoped to establish institutes in the four West African Colonies, to serve as intellectual and cultural centers and to demonstrate the progress made in Britain in the fields of science, pure and applied, literature, art, music and drama. The necessary executive staff is now being assembled.

MAJOR JOHN D. GUTHRIE retired from the U. S. Forest Service on April 30, after having served for thirty-eight years, over two years of which were spent with the American Expeditionary Forces in France and Russia. Major Guthrie was a forest supervisor for some ten years in Arizona and New Mexico and later an assistant regional forester for public relations at Portland, Ore. He will reside in southside Virginia, where he will farm, practice forestry and write.

DR. ALLEN O. WHIPPLE, chief of the surgical division of the Presbyterian Hospital, New York; Brigadier General Frederick H. Osborn, of Garrison, N. Y., now chief of the Special Services of the War Department, and Harvey S. Firestone, Jr., vice-president of the Firestone Tire and Rubber Company, Akron, Ohio, have been elected charter trustees of Princeton University.

DR. HARRY STANLEY ROGERS, president of the Polytechnic Institute of Brooklyn, formerly dean of engineering at Oregon State College and director of the Engineering Experiment Station, has been appointed a member of the New York City Board of Higher Education.

WESLEY C. L. HEMEON, who has been industrial hygiene engineer for the Massachusetts Department of Labor for the past seven years, has become a member of the staff of the Industrial Hygiene Foundation of the Mellon Institute, Pittsburgh.

JOHN FARLEY FOSTER, research chemist for the General Electric Company, Pittsfield, Mass., has been appointed a member of the research staff of the Battelle Memorial Institute, Columbus, and has been assigned to the division of fuels research.

NICHOLAS N. T. SAMARAS and Roy W. Sudhoff, of the Central Research Department of the Monsanto Chemical Company, Dayton, Ohio, have become assistant directors.

DR. J. ROY DOTY, of the Louisiana State University, has been appointed associate chemist in the bureau of chemistry of the American Dental Association.

IT is reported in *Chemical and Engineering News* that G. Potapenko, since 1930 associate professor of physics at the California Institute of Technology, has been appointed technical director of the Aircraft Specialties Company, Los Angeles. He was formerly professor of mining and agriculture at the University of Moscow.

DR. EDGAR A. DOLL, who has been director of the department of research at the Vineland Training School since 1925, has been chosen director of Bonnie Brae Farm for Boys at Millington. For the past seven years he has served Bonnie Brae Farm as consultant psychologist.

DEAN CURRIER MCEWEN, of the New York University College of Medicine, has been granted leave of absence for military duty as lieutenant colonel in the Medical Corps of the U. S. Army. He will serve as executive officer of the Bellevue Hospital Affiliated Unit, the First General Hospital, now in training at Fort George G. Meade, Md. During his absence, Dr. Donal Sheehan, professor of anatomy, will act as dean and Dr. Clarence E. de la Chapelle, professor of clinical medicine, will act as assistant dean in the place of Dr. John H. Mulholland, who was granted military

leave last October to take charge of the Surgical Service of the Bellevue Unit.

DR. GEORGE SPERTI, director of the Institutum Divi Thomae, launched his ocean-going laboratory on April 5 to explore the east and west coastal waters of Florida for algae and seaweeds which yield agar.

DR. JOHN B. LUCKE, associate professor of geology at the University of Connecticut and head of the department, has been granted leave for the duration of the war to accept a commission as lieutenant (jg) in the U. S. Naval Reserve, with orders to report to the headquarters of the Eastern Sea Frontier, New York City.

DR. FRANZ WEIDENREICH, of the American Museum of Natural History, spoke on April 21 on the "Ancestry of Man in the Light of Latest Discoveries" before the annual initiation meeting of the Syracuse Chapter of the Society of Sigma Xi.

EXAMINATIONS are announced for positions in the West Virgina State Health Department, applications for which will be accepted continuously. New registers will be established from applicants who file not later than June 26. These positions for which applications are now being accepted, together with salary ranges, are as given below. Appointments may be made at above the minimum salaries to the following positions: assistant director, Hygienic Laboratory, \$2,640 to \$3,240; senior bacteriologist, \$1,800 to \$2,400; senior serologist, \$1,800 to \$2,400. Residence in West Virginia has been waived in the consideration of applicants for these positions.

THE fiftieth anniversary meeting of the Society for the Promotion of Engineering Education will be held in Chicago on June 18, 19 and 20.

THE New England regional meeting of the American Society for Metals will be held at the Hotel Taft in New Haven on May 22. The meeting will consist of a morning, afternoon and evening session. Information and developments important to war production will be emphasized in the program.

THE role of the scientific man in the war effort and how he can be more fully utilized will be discussed at the forthcoming National Wartime Conference which takes place on May 8 and 9 at the Hotel Commodore, New York City. Dr. Kirtley F. Mather is chairman of the conference, which has arranged for panel and round-table discussions on how essential the scientific worker is to the winning of the war and will ask that greater attention be given to his proper utilization. Among those who will speak are Dr. Otis Caldwell, American Association for the Advancement of Science; Senator Harley M. Kilgore, of the Committee on Military Affairs; Dr. Theodore Rosebury, chairman, New York Branch of the American Association of Scientific Workers; Dr. Albert B. Newman, dean of the Engineering School, College of the City of New York; Dr. John P. Peters, professor of internal medicine, Yale University School of Medicine; Dr. Ernst Boas, president, New York Heart Society, and Dr. Carl E. Rice, senior surgeon, U. S. Public Health Service. The American Association of Scientific Workers, the American Association of Engineers, the American Medical Women's Association, the Medical Administration Service, the Allied Dental Council and the First District Dental Society will participate in the conference.

IMMEDIATELY following the annual meeting of the Association of American Medical Colleges at Cleveland, Western Reserve University will celebrate on October 27 the one hundredth anniversary of the School of Medicine. The program is as follows: In the morning there will be an address entitled "Blood Plasma Proteins, Their Production, Function, Substitution and Replacement" by Dr. George H. Whipple, professor of pathology and dean of the School of Medicine and Dentistry of the University of Rochester. This will be followed by a buffet luncheon for delegates and guests. Dr. Alan Gregg, director for the medical sciences, Rockefeller Foundation, will make an address at the University Convocation in the afternoon on "The Matrix of Medicine." Dr. Reginald Fitz, lecturer on the history of medicine at Harvard University Medical School, will give the dinner address entitled "The Crimson Thread" in the evening.

A TERCENTENARY Commemoration of the Invention of the Barometer will be held at the University of Toronto on October 19. Dr. Louis C. Karpinski, of the University of Michigan, will speak on the "Telescope, Microscope and Barometer as a Point of Departure for the Natural Sciences," and G. S. Brett, of the University of Toronto, will discuss "The Effects of the Discovery of the Barometer on Contemporary Thought." In the evening W. E. Knowles Middleton, of the Meteorological Office, Toronto, will speak on "The Subsequent History of the Barometer." "The Applications of the Barometer in Physics and Chemistry" will be the subject of a paper by Dr. John Satterly, of the University of Toronto.

THE establishment of a new program of instruction in agricultural science in the Sheffield Scientific School of Yale University to provide fundamental training for men planning to enter any of the professional fields related to agriculture or the practice of agriculture itself has been announced. According to a statement made by President Seymour, "The program will mark a new departure in agricultural education. Instead of combining practical with theoretical studies

it will resemble pre-medical training in being limited chiefly to the basic sciences. It will be one of several elective programs in biology and will be parallel to the present courses of study in botany and zoology. It is expected to start at the beginning of the new term on July 1." Work will be offered in the sciences fundamental to agriculture, such as botany, zoology, chemistry, genetics, bacteriology and entomology; it will not attempt to duplicate the training in practical agriculture given in agricultural colleges. Where such training is necessary students will obtain it from other institutions after graduation. The first year of the program will parallel that of most university freshmen, with emphasis on mathematics and science. During the next three years, courses will be given in the basic sciences, especially those most closely related to agriculture. Specialists from the Connecticut Agricultural Experiment Station and the Schools of Forestry and Medicine will be called upon to teach special subjects. The administration of the program will be under the direction of Dean Charles H. Warren, of the Sheffield Scientific School.

DISCUSSION

NATIONAL LEARNED SOCIETY GROUPS AND THE PUBLIC INTEREST

No American scientist can to-day view the world as it is without knowing that an economic, political, educational and moral crisis threatens our very national existence. Probably no group of citizens not in the armed forces has responded more completely than the scientists whether employed in teaching or in scientific state and national bureaus or in private enterprise. Yet the scientists are under widespread attack because large numbers of scientists in government and college employ have sold their services, "on the side," to private interests. Some concerted effort must be made to restore scientific progress to its proper place of primary service to the public interest.

The fact that scientifically America was relatively unprepared is not disputed. Despite the fact that for some years the imminence of a crisis was obvious, yet in stocks of essential metals, rubber and rubber substitutes American scientists and the Army and the Navy made absolutely inadequate preparations.

The "cartel agreements" in aluminum, in rubber substitutes, in minerals vital to all progress in quantity production dependent, for example, on rapid tooling were made with the assistance of many scientists supposedly employed in public service. Our long delay and the deaths of many thousands of our soldiers must still be laid at the door of those who prevented the American housewife from enjoying her right to the aluminum, the electric power and the gas, and the other great achievements of modern science before the war crisis. The monopolistic practises prevented greater production facilities from being developed.

To conduct the war to which Germany and Italy devoted all their resources for so many years has required of England as it requires of America the intense devotion of every resource in England and America that liberty may not perish in the universe.

To secure the participation of the small industries has been and continues to be one of the vital bottlenecks in production. No less a personage than Secretary Ickes has openly charged the National Academy of Sciences with dereliction in its service of the public interests. Private contracts with great corporations made by professors in colleges and by scientists actively on governmental payrolls have prevented the government, *i.e.*, the Army and the Navy from receiving that advice so essential to democratic processes even in quantity production required by the war effort. When Secretary Ickes requested aid from the National Academy of Sciences and even from government agencies such as the Geological Survey, men were given him whose primary interest was in serving the great corporations which these men represented "on the side." These charges were made by Secretary Ickes in open Congressional hearings held for the purpose of aiding the smaller industries.

In view of the fact that public records, notably government publications concerning the activities of the notorious National Electric Light Association wherein hundreds of college teachers including leading men in our foremost technical schools and universities were reevaled to be on the payroll of the association, make it seem imperative that some organized group take up actively the defense of the scientific group as a whole and to make possible that the public interests be served properly by men with only that end in mind.

Towards this end I introduced the following resolution on January 30, 1943, at the New York meeting of the American Council of Learned Societies to which I was an accredited delegate of the History of Science Society.

The American Council of Learned Societies regards with disapproval the extensive inroads made into university and college staffs of America by great corporations and public utilities; these have been revealed somewhat accidentally, and most unfortunately even in connection with criminal actions or other actions affecting the public interest.

In all matters of the public interest, the American Council of Learned Societies affirms its belief that in a democ-

racy the professors in universities and colleges should serve only the public interest.

We recommend to the university and college administrative officers that all teachers in institutions of higher learning be required to note to their college officials their contractual connections with corporations or private or even public utilities. These connections should be noted after the teachers' names in some readily accessible publication for each institution, so that any pronouncements may be judged by the public and the press as to whether such pronouncements emanate from a financial interest or from an academic (unpaid) interest in the public welfare.

Coupled with this resolution it is expected that an act will be introduced into Congress to compel all so-called expert witnesses who testify before Congressional committees to record their affiliations in advance of their testimony and that such connection be properly indicated when the expert testifies.

By such processes Americans may hope that the scientists will re-establish themselves in the confidence of the public which they serve.

I invite correspondence from all members of scientific societies who feel that the movement is worthy of academic and scientific support.

LOUIS C. KARPINSKI,
President, History of Science Society
UNIVERSITY OF MICHIGAN

ABNORMAL NITROGEN METABOLISM IN BURNS

CERTAIN patients suffering from severe burns have shown gross abnormalities in nitrogen metabolism. The observations suggest that the nutritional status of patients with burns needs careful attention.

Eleven of twenty-two severely burned patients excreted excessive amounts of nitrogen in the urine. Sometimes as much as 45 grams were excreted within 24 hours, or an amount equivalent to the catabolism of 250 grams of protein a day. Such losses cause a serious nitrogen deficit.

Large increases in the residual nitrogen of the urine, both in the absolute amount and in the percentage of the total nitrogen excreted, occurred in some of the patients. Sometimes 80 per cent. of the nitrogen excreted was in this form.

Plasma studies showed a similar abnormality in the nitrogen partition. There was present an azotemia with an increase of urea, but the residual nitrogen of the blood plasma was also markedly increased.

At present it is not possible to state whether the residual nitrogen present in the blood and urine is polypeptide nitrogen, as suggested by other observers.[1, 2] However, it does yield by hydrolysis large amounts of amido and amino nitrogen. The findings are consistent with the presence in both blood and urine of a protein metabolite of high molecular weight.

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STANLEY M. LEVENSON
CHARLES S. DAVIDSON
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HARRIET MACDONALD

THORNDIKE MEMORIAL LABORATORY,
2ND AND 4TH MEDICAL SERVICES
(HARVARD) AND THE BURNS COMMITTEE, BOSTON CITY HOSPITAL,
AND DEPARTMENT OF MEDICINE,
HARVARD MEDICAL SCHOOL, BOSTON, MASS.

The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Harvard University.

[1] P. Duval, J.-Ch. Roux and Goiffon, *Presse Med.*, 42: 1785, 1934.

[2] O. Lambret, J. Driessens and H. Malatroy, *Compte Rend. Soc. de Biol.*, 123: 12, 1936.

TYPES OF ARGENTINIAN PLANTS OF SPEGAZZINI

ALL taxonomists working intensively on the flora of South America must necessarily evaluate the many hundreds of species of all groups of vascular plants of Argentina described by the late Carlos Spegazzini (1858–1926). As further exploration of Argentina and adjacent countries brings to light additional species it becomes increasingly important to understand exactly what Spegazzini had as types of his species. This need is now being met through the far-seeing interest of the Department of Botany of the Museo de La Plata of the Universidad de La Plata. Professor Angel L. Cabrera, in charge of the Section of Phanerogams, is supplying five or six of the leading herbaria of the world a complete series of photographs of these types. The first series of 100 prints with detailed labels has just reached the Gray Herbarium. The glossy prints, 12 × 17 cm, are beautifully prepared. These and the series soon to follow will be invaluable to all students of South American plants.

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OPTICAL ILLUSIONS FROM TRAIN WINDOWS

IF one is riding forward rapidly in a train traversing prairie country with wide vistas, the landscape one passes seems to be a circle revolving counter-clockwise with the center at the horizon on a radius at right angles from the tangent on which the train seems to be moving.[1] If now the train stops, the movement of the illusory circle seems to reverse and move majesti-

[1] The circular motion described is observed from the right side of the train, and of course is reversed from the left.

cally in a clockwise direction. This illusion seems more frequently observable when one is tired.

One might explain the illusion by the persistence of small lateral eye muscle movements adjusting the eyeball to the forward movement of the train, so that when the train stops, and the rhythmic eye muscle motion persists, the landscape appears to move in the opposite direction to that which was the case when the train was in motion.

On the other hand, perceptive factors may be involved. If one goes to the rear of the train and watches the landscape continually recede as the train progresses forward, there will be a similar illusory reversal when the train stops. That is, the landscape instead of continually receding will now appear to be rolling toward the stationary observer. This illusion may be due to rhythmic persistence of the activity of muscles of accommodation.

It may be that these factors are important in the etiology of motion sickness.[2] In the case of the vestibular apparatus, there is no rhythmic muscular action involved. However, it is a common experience to continue to feel a ship's motion after one comes ashore. This raises the question as to whether or not the optical illusions noted in connection with a moving train may not involve persistence of the temporarily established receiving pattern, in addition to the possibility of involving persistence of rhythmic and adaptive muscular activity.

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SCIENTIFIC BOOKS

SYSTEMATICS

Systematics and the Origin of Species. By ERNST MAYR. Columbia University Press. 334 pp. 29 figures. 1942. $4.00.

WITHIN recent years there has been manifest in the writings of taxonomists an altered position which has been called "the new systematics," although the only novelty manifest is in the approach to the subject. The present work is by one of the adherents of this movement, who says in his preface that animal taxonomy has undergone a revolution almost as fundamental as that which occurred in genetics after the rediscovery of Mendel's laws. While one may doubt the accuracy of the statement no one can question that a new view-point dominates the field. Undoubtedly the efforts of the early taxonomists to apply names to organisms that would permanently designate them has given way to the recognition that no two organisms are ever exactly alike and that accordingly any common name is very unlike in its value in different groups. This uncertainty is indeed recognized by the author, for he says: "There is no uniform point of view among taxonomists, in fact in regard to many of these questions there may not even be a majority opinion." In seeking for an explanation of this state of affairs he says that it is not yet clear, but he goes on to point out the need for a full knowledge of the group as a prime necessity for an agreement. He makes it clear that ornithology has reached such a stage of advancement that less than 2 per cent. of the bird species of the world remain unknown, and that therefore bird classification occupies a very favorable position for future developments. Indeed the attitude of the author is one which makes for a much better understanding of the relations of living things. For him not only is taxonomy important, but also genetics, ecology and paleontology contribute toward this end. Taxonomy takes on a larger and larger aspect and brings more and more of these problems into a common biological relationship.

In this book we find a discussion of these problems with many illustrative references, particularly to birds. The author is appreciative of the contribution made by genetics, although he recognizes the peculiar approach which it makes to the subject. The geneticist seeks an understanding of the mechanism of the "biological atoms" in their movements and changes, while the taxonomist deals with groups of organisms in their relation to the environment and to each other. Each side has its own peculiar characteristics of physical and biological factors, and taxonomy is busy selecting between the products of genetic action. The result is that there are nowhere two populations which are identical, if a fine enough analysis is made. This leads directly to the smallest group, the subspecies, and in turn to the species, genus, family, order and class. Since it is with groups that the author primarily deals it is important to find out how he regards them. At once it may be said that he has no conception of a fixed and invariable relation. He regards the species as a dynamic concept, which differs in range and character with the degree of knowledge of the group. He is at pains to point out the growing number of polytypic species as the years pass and more knowledge accumulates. At the same time he realizes the large subjective element in the consideration and the difference in the regard of the systematist and the evolutionist for the same group. For the systematist

[2] Indeed, if a large mirror is before the observer in the situation described in the first paragraph, so that the passing landscape may be seen in reverse motion to that noted from the window, the observer may become uncomfortable or even nauseated by looking alternately through the window and then in the mirror.

the species is a "practical device," a necessary conception for reducing the endless variety of forms to some system; for the student of evolution it is merely a "passing stage in the stream of evolution." He wishes to know how it came into being and whither it leads.

But for both a definition is desired, but it can only be approximate and must be regarded as a convenience of varying value. As yet it is quite impossible to define "species," for the definition depends upon the degree of our knowledge of the group, but he endeavors to reach it by framing definitions of the "practical species concept," the "morphological concept," the "genetic species concept," the "concept based on sterility" and the "biolo-species definition." From all these we emerge with the definition: "Species are groups of actually or potentially interbreeding natural populations which are reproductively isolated from other such groups." Accordingly the test is purely physiological, despite the author's choice of a morphological one. As to the method of origin of a new species it is stated as follows: "A new species develops if a population which has become geographically isolated from its parental species acquires during the period of isolation characters which promote or guarantee reproductive isolation when the external barriers break down." There must therefore exist all degrees of speciation, in which final separation into definite groups is at length attained. A discussion of this question occupies Chapter VII, and non-geographic speciation the following one, with biology of the process forming the substance of the third. We come then to a discussion of the higher categories in evolution, of which the genus is typical. Mayr quotes Thorpe, who defines the genus thus: "A genus is a systematic unit including one species or a group of species of presumably common phylogenetic origin, separated by a decided gap from similar groups." The recognition of this assemblage is regarded as a purely subjective affair, there being no real limits. The book finally ends with a discussion of macro- and micro-evolution factors, where the author reaches the conclusion that "all the available evidence indicates that the origin of the higher categories is a practice which is nothing but an extrapolation of speciation. All the processes and phenomena of macroevolution and the origin of the higher categories can be traced back to intraspecific variation, even though the first steps of such processes are usually very minute."

C. E. McClung

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VOLUMETRIC ANALYSIS

Volumetric Analysis, Vol. I. I. M. Kolthoff and V. A. Stenger. Second revised edition. xv + 309 pp. 31 figs. 15 × 23 cm. New York: Interscience Publishers, Inc. 1942. $4.50.

This book is the first of a two-volume set covering the field of volumetric analysis. In revision, it closely follows the organization of the earlier German edition and its English translation. Volume I deals with theoretical principles, and Volume II, now in preparation, is to consider practical principles.

The book capably deals with the underlying theory of acid-base neutralization, oxidation-reduction, complex-formation and precipitation as related to volumetric analysis. In addition, there are general chapters which discuss titration errors, induced reactions, catalysis, mixed crystal formation and coprecipitation, indicators, organic analysis and physical methods of finding the equivalence point. In the revised edition, a large amount of new material has been added to the discussion of redox indicators; and a section has been added covering the rather new field of amperometric or polarimetric titrations. The chapter on organic volumetric methods has been extensively revised; however, it does little more than exemplify the application of the general theory of volumetric analysis to a few typical problems arising in the organic field. Throughout the book new references have been added, and the appendix has been changed to include new data and to take into consideration the activity principle.

The physical make-up of the book is good. The print is large and easy to read, and the binding is attractive.

The volume is highly recommended to any one interested in volumetric analysis, and should be considered an indispensable part of the library of those engaged in the development or improvement of volumetric methods.

QUANTITATIVE ANALYSIS

Analytical Chemistry, Vol. II, Quantitative Analysis. F. P. Treadwell and W. T. Hall. Ninth English edition. xi + 806 pp. 121 figs. 15 × 23 cm. New York: John Wiley and Sons. 1942. $6.00.

This, the quantitative volume of a two-volume set, describes in detail well-known gravimetric and volumetric methods for the ions and common methods of gas analysis.

In this ninth edition, the scope of the book is unchanged from previous editions. In many cases, newer well-tried methods have replaced older ones, and the older methods have been brought up to date.

There has been a significant change in the make-up and arrangement of the book. The sections on gravimetric, volumetric and gas analysis have been divided into chapters, and the section of tables has been enlarged and brought up to date. The chapters in

the gravimetric section correspond to the ion groups of the ordinary scheme of qualitative analysis. The volumetric section is divided according to type of reaction, such as oxidation-reduction, acid-base neutralization, and others. This new arrangement makes for a much more attractive and useful volume.

FREDERICK R. DUKE

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SPECIAL ARTICLES

THE ROLE OF "FOLIC ACID" AND BIOTIN IN THE UTILIZATION OF PANTOTHENIC ACID BY THE RAT

THE inclusion, in *highly purified diets* fed to rats, of sulfaguanidine or of succinylsulfathiazole brings about a retardation of growth; after growth ceases the animals lose weight and usually die within a few weeks. The effect of these drugs has been attributed to their interference with the synthesis of essential factors by intestinal bacteria.[1] This explanation is supported by the fact that sulfaguanidine is partially retained in the intestine,[2, 3] while about 95 per cent. of ingested succinylsulfathiazole fails to be absorbed from the alimentary tract.[4, 5] Recently Nielsen and Elvehjem,[6] using succinylsulfathiazole, reported that supplementation with biotin and concentrates of "folic acid" caused a striking resumption in growth which was maintained during several weeks therapy. Martin,[7] who used sulfaguanidine, obtained similar results. We[8] have presented detailed evidence in confirmation of the findings of Nielsen and Elvehjem.

In addition to the cessation of growth, rats fed the sulfonamide in purified diets[9] frequently develop signs of marked pantothenic acid (PA) deficiency, such as achromotrichia and porphyrin-caked whiskers.[8] The fact that "folic acid" (biotin was also present) will cure the achromotrichia produced by sulfaguanidine feeding was attributed by Martin[7] to a chromotrichial action of this factor.

We have found that the signs of PA deficiency in rats are borne out by microbiological assays of the PA content of the liver.[10] Liver obtained from rats on a complete diet[11] or on the highly purified diet without sulfonamide contained 80–90 μgm of PA per gram. Rats fed the purified diet, without either PA or succinylsulfathiazole, developed signs of severe PA deficiency, and the liver tissue contained only 40–50 μgm of PA per gram. Rats fed the purified diet with succinylsulfathiazole (2 per cent.) showed marked evidence of PA deficiency, despite the presence in the diet of adequate amounts of PA (4 mgm per 100 gm), and the PA content of the liver was reduced to only 40–50 μgm per gram. Further increase in the PA content of the diet (10 mgm per 100 gm) caused no favorable effect. Administration of PA subcutaneously, 200 μgm daily, also was without influence on the diminished content of PA in the liver or on the severely depressed rate of growth.

When the purified diet was supplemented with succinylsulfathiazole (2 per cent.) and dried grass[12] (5 per cent.) the PA content of the liver was raised to a value (50–70 μgm per gram) intermediate between normal levels and those produced by the basal diet with added sulfonamide. However, this moderate increase in liver PA content was accompanied by a growth rate comparable to that of rats on the basal diet.

The oral administration of crystalline biotin[13] (5 μgm daily) for a period of 3 weeks caused a slight increase in the PA content of the liver and some improvement in the rate of growth of the succinylsulfathiazole-fed rats. When, however, in addition to biotin (5 μgm), a "folic acid" concentrate[14] (20 mgm

[1] S. Black, J. M. McKibbin and C. A. Elvehjem, *Proc. Soc. Exper. Biol. Med.*, 47: 308, 1941.

[2] E. K. Marshall, Jr., A. C. Bratton, L. B. Edwards and E. Walker, *Bull. Johns Hopkins Hosp.*, 68: 94, 1941.

[3] W. M. Firor and E. J. Poth, *Annals of Surg.*, 114: 663, 1941.

[4] E. J. Poth and F. L. Knotts, *Proc. Soc. Exper. Biol. Med.*, 48: 129, 1941.

[5] A. D. Welch, P. A. Mattis and A. R. Latven, *Jour. Pharmacol. and Exper. Therap.*, 75: 231, 1942.

[6] E. Nielsen and C. A. Elvehjem, *Jour. Biol. Chem.*, 145: 713, 1942.

[7] G. J. Martin, *Proc. Soc. Exper. Biol. Med.*, 51: 353, 1942.

[8] A. D. Welch and L. D. Wright, *Jour. Nutrition*, in press.

[9] Composition of diet: casein (Labco) 18 gm, fat (Primex) 10 gm, corn oil 2 gm, sucrose 61.9 gm, salts 4 gm, cellu flour 4 gm, vitamins A, D and E concentrate 0.08 gm, choline chloride 0.1 gm, thiamine hydrochloride 0.2 mgm, riboflavin 0.4 mgm, pyridoxine hydrochloride 0.2 mgm, nicotinic acid 4 mgm, calcium pantothenate 4.4 mgm, p-aminobenzoic acid 4 mgm, inositol 8 mgm, 2-methyl-1,4-naphthohydroquinone diacetate 1 mg.

[10] Some of the liver samples were prepared for assay after autolysis as described by L. D. Wright, *et al.*, University of Texas Publication, 4137: 38, 1941. We now employ enzyme digestion of the liver samples with takadiastase, as recommended by V. H. Cheldelin, *et al.*, University of Texas Publication 4237: 15, 1942. With liver samples autolysis liberates approximately 90 per cent. of the pantothenic acid found after enzyme treatment. Pantothenic acid was determined by either the method of D. Pennington, *et al.*, *Jour. Biol. Chem.*, 135: 213, 1940, or the method of M. Landy and D. M. Dicken, *Jour. Lab. and Clin. Med.*, 27: 1086, 1942.

[11] Purina chow.

[12] Powdered grass ("Cerophyl") was generously supplied by Dr. Richard Graham, of the Cerophyl Laboratories, Kansas City, Mo.

[13] We are indebted to Dr. Hans Molitor, Merck Institute for Therapeutic Research, and Dr. W. H. Engels, Research Laboratories, Merck and Company, for a generous gift of crystalline biotin.

[14] Prepared from "Cerophyl" by the procedure described by B. L. Hutchings, N. Bohonos and W. H. Peterson, *Jour. Biol. Chem.*, 141: 521, 1941. This concentrate contained approximately 800,000 Snell-Peterson units of "folic acid" per gram.

daily) was administered orally, not only was the growth rate of the rats restored to a rate comparable to that produced by the basal diet, but also the PA content of the liver was increased to a level entirely within normal limits.

TABLE I

CHANGE IN WEIGHT AND PANTOTHENIC ACID CONTENT OF LIVER OF RATS FED SUCCINYLSULFATHIAZOLE*

Group	Daily supplement	Number of animals	Change in weight gm	Pantothenic acid content of liver μgm/gm
1	None	3	− 8	48 (47–49)
2	Cryst. biotin 5 μgm.	3	+16	57 (55–61)
3	Cryst. biotin 5 μgm + "folic acid" concen. 20 mgm	3	+46	81 (80–82)
–	Pantothenic acid deficient rats (for reference)	3	–	46 (44–49)
–	Rats on "Purina" chow (for reference)	4	–	89 (88–91)

* The groups (1–3) were composed of animals which had received succinylsulfathiazole in the purified diet for a period of 12 weeks. At that time the livers of 3 such animals were found to contain 40 (33–46) μgm of PA per gram. The supplements were administered once daily (except Sundays) by stomach tube during a period of 3 weeks.

These data suggest that for the proper utilization of PA by the tissues of the rat "folic acid," in addition to biotin, must be available. It is probable that the effect of "folic acid" on PA utilization occurs only in the presence of biotin, since a significant growth response in the rat follows the administration of "folic acid" only when biotin is also given.[8] It is unlikely that orally administered PA is inactive because of any interference with its absorption from the alimentary tract caused directly or indirectly by the sulfonamide, since parenterally administered PA is also quite ineffective.

Conceivably, the effect of these substances might be due to counteraction of the effect of the sulfonamide. However, *in vitro* studies of the effect of the "folic acid" concentrate on the bacteriostatic action of sulfathiazole (1:8,000,000) on *E. coli* showed that in a concentration of 1:3500 it had no activity not attributable to p-aminobenzoic acid, or to other heat-acid stable constituents.[15] p-Aminobenzoic acid, it will be noted, was present in the diet to the extent of 4 mgm per 100 gm.

An attractive hypothesis suggests that in the absence of "folic acid" and biotin, PA can not be utilized by the organism. Whether the influence of these trace-factors on PA utilization results from an effect on the synthesis of PA derivatives by intestinal bacteria, from an effect on the synthesis of such derivatives by the tissues of the rat, or from other effects, has not yet been established. Experiments bearing on these points are now in progress.

[15] We are indebted to Dr. Lawrence Peters of this laboratory for the experiments with *E. coli*.

According to the views presented, the basic fault, when hair pigmentation ceases following the use of purified diets containing poorly absorbed sulfonamides, actually may be the improper utilization of PA, so that the end result may be comparable to the exclusion of PA from the diet. Rather than as chromotrichial agents, *per se,* either "folic acid" or biotin might be considered as concerned primarily with PA metabolism. Possibly a similar explanation may be applied to the growth effects of these factors.

The growth stimulation sometimes caused by p-aminobenzoic acid is now believed to result from the stimulation of intestinal microorganisms to produce unknown factors. It has been shown that p-aminobenzoic acid will stimulate the synthesis of "folic acid" by the intestinal bacteria of the chick, *in vitro.*[16] It might be reasoned that the controversial anti-gray hair action and growth effects of the former substance result from a stimulation of the bacterial synthesis in the intestine of "folic acid," and perhaps of biotin. These, in turn, improve the utilization of available PA. Such a hypothesis suggests that any chromotrichial action of p-aminobenzoic acid may be mediated through "folic acid" and biotin, and that the chromotrichial effects of the latter substances are secondary to that of pantothenic acid.[17]

SUMMARY

The addition of succinylsulfathiazole to *highly purified diets* containing all dietary factors known to be required by the rat, including pantothenic acid, results in the appearance of signs of severe pantothenic acid deficiency, including achromotrichia and porphyrin-caked whiskers. These changes are accompanied by a marked reduction in the pantothenic acid content of the liver, and are corrected by the inclusion in such diets of crystalline biotin and "folic acid" concentrates. The utilization of pantothenic acid by the rat appears to depend on the availability of biotin and "folic acid." Under normal conditions these are supplied by the diet and synthesized by intestinal bacteria.

A hypothesis is offered in explanation of the chromotrichial actions of "folic acid," biotin and p-aminobenzoic acid.

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SHARP AND DOHME, INC.,
GLENOLDEN, PA.

[16] G. M. Briggs, Jr., J. D. Luckey, R. C. Mills, C. A. Elvehjem and E. B. Hart, *Proc. Soc. Exper. Biol. Med.*, 52: 7, 1943.

[17] This interpretation of certain effects of "folic acid" and biotin obviously does not exclude them from the performance of other roles in living processes.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF FIBROUS SODIUM PECTATE AS A SUBSTITUTE FOR AGAR IN BACTERIOLOGICAL GELS

THE war has stopped importation of agar and, because facilities for its manufacture in America are not sufficient to meet the demand, the development of a suitable substitute for use in bacteriology is of extreme importance.

In this laboratory certain mixed metallic salts of fibrous pectic acid have proved satisfactory. The preparation and properties of fibrous sodium pectate have been reported by Baier and Wilson.[1] It should not be confused with the ordinary granular form which is not suitable for the purpose described. Fibrous sodium pectate may be purchased on the market[2] but is more satisfactory if purified by suspending it in 60 per cent. alcohol, adjusting the pH of the suspension to 7.5 with sodium hydroxide, filtering the pectate and drying it *in vacuo* at 60° C.

In preparing a nutrient gel, fibrous pectate to make a 2.5 per cent. solution is added to a nutrient broth which should contain 2 mg of calcium ion per gram of pectate in addition to the amount already present in the broth. A test should be made on the nutrient broth with a calcium salt to be sure that no ions are present which precipitate calcium, since that ion is necessary for the formation of the gel. Complete dispersion of the pectate is obtained by heating the mixture above 80° C. The medium is sterilized in the usual manner.

When preparing counting plates care must be taken to insure complete mixing of the bacterial suspension and pectate medium, which is somewhat more viscous than a similar agar medium. Plates should be allowed to stand at least 30 minutes prior to inversion and incubation. Pour-temperature after one autoclaving is between 45 and 50° C. The medium can be remelted in an autoclave, but each remelting raises the gelling temperature five to ten degrees.

Nutrient gels prepared with sodium calcium pectate show a smaller change of pH on sterilization than do similar agar gels. The water retention ability is slightly better than that of agar. Most organisms tested grow on pectate media without causing liquefaction and the fact that some do cause liquefaction may offer a means of differentiating them. Many tests[3] have been made on the action of microorganisms on pectate media, typical results being illustrated in Table 1.

TABLE 1
ACTION OF MICROORGANISMS ON PECTATE MEDIA

Microorganism	Growth	Liquefaction
Bacillus danicus	good	none
Escherichia coli	"	"
Pseudomonas fluorescens	"	"
Proteus vulgaris	"	"
Staphylococcus albus	"	"
Aerobacter aerogenes	"	"
Salmonella enteriditis	"	"
Bacillus subtilis	"	positive
Sporosarcina ureae	"	"
Vibrio cholerae	fair	none
Leuconostoc dextranicus	poor	"

The results in Table 1 are a representative sample of the 58 organisms tested. The growth of molds has not been tested on pectate media in this laboratory; however, the Fermentation Division, Northern Regional Research Laboratory, Peoria, Illinois, has reported that a number of molds grew well on them. Only three of those examined, *Rhizopus oryzae,* an *Aspergillus niger* and a *Penicillium italicum,* liquefied the pectate.

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ALBANY, CALIF.

[1] W. E. Baier and C. W. Wilson, *Ind. Eng. Chem.*, 33: 287, 1941.

[2] California Fruit Growers Exchange, Ontario, California.

[3] We express our appreciation to Ruth M. Chesbro, R. O'Neal and C. S. York, Department of Bacteriology, University of California, for their bacteriological testing.

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SCIENCE NEWS

Science Service, Washington, D. C.

THOMAS JEFFERSON

THOMAS JEFFERSON'S two hundredth anniversary was given special observance at the annual spring meeting of the American Philosophical Society. For 1943 marks also a bicentennial milestone in the history of the society. It was in 1743, the year of Jefferson's birth, that the little informal club called "Junto," which Benjamin Franklin had got together to discuss scientific and other scholarly matters, was formally organized under the full title which it still retains: "The American Philosophical Society Held at Philadelphia for Promoting Useful Knowledge."

Thomas Jefferson was a young man and Benjamin Franklin was old when the two worked together in the cause of American independence; but the two could meet on common ground at many points. Science, especially physical and mechanical science, was one of the best-established of the common fronts existing between the elderly Philadelphian and the youthful Virginian; both liked to try to find out what made things go, and both had a decided bent towards the invention of ingenious and practically useful gadgets, like Franklin's lightning-rod and heating-stove and Jefferson's improved mold-board plow.

At one point, however, they diverged: Franklin was a city businessman, Jefferson was by choice a farmer. In this, Jefferson was more nearly at one with his fellow-Virginian, George Washington. This aspect of Jefferson's life and interests was discussed at the meeting of the Philosophical Society by M. L. Wilson, director of extension work in the U. S. Department of Agriculture. Owner of a hill farm (for Monticello stands on a mountaintop), Jefferson was one of the country's first practitioners of soil conservation methods, including the contour-plowing that is now being preached as the newest thing in soil-saving devices. He also introduced new plants and improved livestock varieties brought from Europe, and was an early believer in crop rotation.

Jefferson founded the University of Virginia (it is the one boast of achievement carved in his epitaph) just as Franklin was active in the establishment of the University of Pennsylvania. In one of his statements of desirable university policy, Jefferson came out positively for the inclusion of agricultural science among the subjects to be taught—something of a novelty in a day when higher education still centered almost exclusively around the classics. Yet Jefferson is not to be counted among educational leaders who place sole emphasis on the scientific and "practical" to the neglect of the classics and the humanities. He was himself well educated in Latin and Greek, but in his hands the old languages were not "dead," as Dr. Louis B. Wright, of the Henry E. Huntington Library and Art Gallery, pointed out. "In the early years of the republic," Dr. Wright reminded his hearers, "the classics had not yet foundered on the arid shores of pedantry."

Jefferson once declared: "No occupation is so delightful to me as the culture of the earth." Translated into Latin, that could easily be passed off as a quotation from the Georgics, Vergil's great poetic work in praise of country living.—FRANK THONE.

A THEORY OF GRAVITATION

A THEORY of gravitation that makes it a push instead of a pull, thus avoiding the bugbear of action at a distance, and makes it a repulsion deep within the stars and planets, was presented by Anatol James Shneiderov at the meeting of the American Geophysical Union. Mr. Shneiderov holds the Russian degree of "Magister in Military Engineering" and is also a civil engineer. He is at present on the faculty of the George Washington University, where the meetings were held.

There is something occult about the motion of force at a distance, Mr. Shneiderov said. His theory is in a sense a modernized version of the theory of the Swiss scientist Le Sage, proposed some years ago. According to this theory, streams of particles incessantly traversing space in all directions impinge upon the farther sides of two planets or other celestial objects, but are screened from the nearer sides by the planets themselves, and so push them together.

In place of streams of particles, Mr. Shneiderov substitutes streams of energy. These pass through matter, losing energy as they go. He has developed a formula for the force produced which is more complicated than Newton's, but not as complicated as Einstein's. Outside a planet it gives the same force as Newton's law, and agrees with Einstein when account is taken of the increase of mass with the speed.

But inside a planet, Mr. Shneiderov gets very different results. The attractive force diminishes below the surface down to a certain level, where it becomes a repulsion which then increases exponentially the rest of the way to the center. According to Newton, the attractive force diminishes continually and becomes zero at the center. According to Mr. Shneiderov the force around the center of the earth is so great that all atoms are disintegrated, the nuclei stripped of the surrounding electrons. The core of the earth thus becomes an "electronic gas." This explains why the core does not transmit transverse earthquake waves which it would if it were solid as hitherto supposed.

These great forces in the deep interior of the earth are mainly responsible for earthquakes, and Mr. Shneiderov believes that a fuller understanding of them may lead to the possibility of predicting earthquakes long before they happen.—MORTON MOTT-SMITH.

MEASUREMENT OF LARGE QUANTITIES OF WATER

RADIUM in tiny quantities may be used to measure large masses of water, but the method is not as simple as it seems at first glance, was pointed out by Dr. Victor F. Hess, German Nobel prizeman in physics now at Fordham University, at the Washington meeting of the American Geophysical Union.

Some indirect means is desirable for accurately measuring large quantities of water in reservoirs, where direct weighing is not possible. One method that has been tried has been to dissolve a lot of salt in the water, then collect a sample of it as it comes out of the tailrace of the power plant and determine the salt concentration in that.

Some time ago the noted French physicist, Dr. J. Joly, suggested the use of minute amounts of radium, which diffuse rapidly and evenly in water, but he did not do any experimental work on the method himself. Dr. Hess has done so, making use of a large tank in Pennsylvania, loaned for the purpose by a power company.

Sources of error were found to be more numerous than anticipated. There was a tendency for part of the radium to become tied up in insoluble form with "hardening" chemicals in the river water; this could be partly overcome by adding hydrochloric acid. Minute but variable amounts of radium are naturally present in the water, so that their effect has to be measured in advance and proper allowances made. Even the type of glassware used in the laboratory may falsify results unless great care is exercised. Dr. Hess concluded by cautioning his hearers not to "attempt blindly to set out to measure large volumes of water with too little radium."

LIGNITE DEPOSITS OF THE UNITED STATES

THE huge lignite deposits in the United States are a potential source of war power was reported to the American Society of Mechanical Engineers by Professor C. J. Eckhardt, Jr., and C. W. Yates, of the University of Texas. Only an insignificant fraction of the nation's 939 billion ton reserve is being utilized. But soaring fuel consumption to meet war needs brings increased attention to this low-rank fuel.

Lignite, often called "brown coal," is more widely used in Europe than America. It appears to be a halfway station between wood and coal, occurring at a more youthful age than its true coal relatives.

Lignite contains more water and ash than ordinary coal. But misconceptions are commonly held about the properties of lignite that stand in the way of its more extended use. "The failure to use appropriate grate surfaces has caused this fuel to be maligned with regard to sifting losses from size reduction of the fuel particles as heat is applied and moisture is driven off. Yet the water losses are no greater than those of some of the more admirable fuels and the size reduction while this fuel burns can be rendered inconsequential. The most serious misconceptions relate to its tendency to undergo size-reduction processes while in storage and while being handled."

More than a sixth of the nation's mineral-fuel reserve is lignite. Principal deposits are mainly in Texas, Montana and the Dakotas, where no mountain-making movement of the earth's crust has occurred.

ITEMS

OCEAN current surveys for the Navy will be made this spring on the Atlantic Coast by floating radio robots—boat-like metal buoys with radio masts fifteen feet high. A streamlined meter containing a compass will be suspended from each buoy to record the velocity and direction of the current. It automatically broadcasts this to the mother ship. At the receiving end, the radioed impulses of the meter are recorded by a robot mechanism in groups of three; the distance between two of the "ticks" giving the velocity and the location of the third between them giving the direction of the current. Dr. L. O. Colbert, of the U. S. Coast and Geodetic Survey, speaking before the American Geophysical Union stated that the new radio current meter decreases the number of vessels needed for such a survey as simultaneous observations can be made at several current stations. Another advantage is that the streamlined current buoys can remain at their posts during bad weather and in strong currents with less difficulty than a ship anchored under similar conditions.

A PHOTOGRAPHIC recorder used to replace previous methods of obtaining a series of wind velocity measurements was described at the meeting of the American Geophysical Union by Dr. Leonard B. Corwin, of the U. S. Soil Conservation Service. Dr. Corwin stated that the recorder was developed to secure simultaneous measurements of wind velocity at several different levels where electrical power was unavailable. The dials or faces of several counters were photographed as the simplest and surest way to obtain multiple records. By adjustments, photographic observations could be obtained at intervals of one minute up to an hour or more. Dr. Corwin stated that the photographic recorder "appears to offer a means of obtaining an autographic record of many if not most meteorologic and climatic values." Further simplification of the apparatus is contemplated.

SYNTHETIC plastic material to supplement the available supply of mica necessary in war-used electrical equipment is promised in the near future. Priorities have been granted for the materials to construct a plant where the synthetic product will be made. It is expected that the plant will be in production about July 1. The material is a synthetic polymerized resin. It is reported to have high temperature resistance and low dielectric loss. These properties will permit its use in several types of radio equipment now requiring mica. It will be known under the trade name of Polectron. This new plastic is a product of the General Aniline and Film Corporation. It has been tested for the corporation by the laboratories of the Massachusetts Institute of Technology and those of one of the large industrial companies making electrical apparatus. It has been tested also at Wright Field. Much of the mica now in use is obtained from India and Brazil. It has been called by the War Production Board an urgently needed raw material vital to mechanized warfare, and mica users and fabricators were warned many months ago to conserve the supply in every way possible. One ton of the new plastic, fabricated into mica replacement material, will replace from ten to fifteen tons of the imported block mica, it is expected, thus saving much strategic material.

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MEDALS OF THE NATIONAL ACADEMY OF SCIENCES[1,2]

MEDAL PRESENTATIONS: REMARKS BY THE PRESIDENT

ANNUALLY at this time presentation of medals and awards is made by the academy. These are bestowed by formal vote of the academy acting on the recommendations of special committees charged with the responsibility of administering the several trust funds.

Normally the occasion of the bestowal is at a dinner to which the academy invites a number of distinguished men and women to be guests. This year, because of the exigencies of war, the dinner is necessarily confined to the members and the medalists. Although, therefore, the setting for the presentations this evening lacks the brilliance of former occasions, I can assure our medalists that it lacks nothing in the esteem in which the academy holds them and their work.

[1] Meeting at Washington, D. C., April 26 and 27.
[2] The presentation of medals was made at the annual dinner, April 26.

To-night we have five medals to bestow. Two of them are governed by the same trust fund and under its terms are in recognition of distinguished work published in specific years. With some of the medals go monetary awards and diplomas. The medalists will be presented by the chairman or a representative of the trust fund committee which made the nomination to the academy.

The medals will be awarded in the order of establishment of the trust funds.

The first award is that of the Henry Draper Gold Medal to Ira Sprague Bowen, and the citation is: "in recognition of his contributions to astronomical physics; more especially his researches on the spectra and chemical composition of the gaseous nebulae." Dr. S. A. Mitchell will present the medalist.

The Draper Fund was established on April 13, 1883, by deed of gift from Mary Anna Palmer Draper ($10,000 and die), and the deed of establishment provides interest and income to be used for the medal to

be ". . . awarded and presented from time to time, but not oftener than once in two years, by the said National Academy of Sciences to any person in the United States of America or elsewhere—for original investigations in astronomical physics, the results of which shall be made known to the public. . . ." This is the twenty-sixth award of the medal.

The second award is that of the Alexander Agassiz Gold Medal and an accompanying honorarium of $300 to Columbus O'Donnell Iselin, II, and the citation is: "for his studies of the Gulf Stream system, for his leadership in the development of a general program of the physical oceanography of the North Atlantic, and for his distinguished direction of the activities of the Woods Hole Oceanographic Institution, both in peace and in time of war." Dr. Barbour will present the medalist.

The Murray Fund, which established the Agassiz Medal, was established on April 22, 1911, by letter and deed of gift from Sir John Murray of $6,000. In his letter Sir John Murray said, "I enclose you a cheque for $6,000 (£1,233) which sum I trust the National Academy will accept from me, for the purpose of founding an Alexander Agassiz gold medal, to be awarded for original contribution in the science of oceanography to scientific men in any part of the world, whenever and as often as the President and the Council may deem desirable." This presentation is the nineteenth award.

The Daniel Giraud Elliot Medal and award of $200 is to be given for the year 1935 to Edwin H. Colbert, who will be presented by Dr. Gregory, and for the year 1936 to Robert Cushman Murphy, who will be presented by Dr. Harrison. The Daniel Giraud Elliot Fund was established on April 17, 1917, by gift of $8,000 from Miss Margaret Henderson Elliot to carry out a testamentary provision in the will of her father, Daniel Giraud Elliot; the deed of gift stipulates: "One such medal and diploma shall be given each year . . . with any unexpended balance of income for the year . . . to the author of such paper, essay, or other work upon some branch of zoology or paleontology published during the year . . . etc." Award is made to Dr. Colbert in recognition of the high merits of his work, "Siwalik Mammals in the American Museum of Natural History," published in the *Transactions* of the American Philosophical Society in 1935. This presentation is the eighteenth award. The nineteenth award is made to Dr. Murphy in recognition of the high merits of his work, "Oceanic Birds of South America," published in two volumes in 1936.

The final award is that of the John J. Carty Medal and award for the advancement of science, for which the honorarium is $4,000 for this year to Edwin Grant Conklin. The citation is: "Zoologist, Cytologist and Embryologist; Philosopher, Teacher and Scientist; Student of life and of growth from lowliest beginnings to highest consummation." The medalist, who is the fourth to receive the award, will be presented by Dr. O. E. Buckley. The Carty Fund was established on November 13, 1930, by deed of gift from the American Telephone and Telegraph Company ($25,000) in recognition of the distinguished achievements of John J. Carty. The deed of gift stipulates a gold medal and monetary award ". . . for specific accomplishment in some field of science or for general service in the advancement of fundamental and for applied science." The award is to be bestowed without limitation as to race, nationality or creed of the individual sought to be honored, and the method of selecting a candidate is to be wholly at the discretion of the academy.

The medal and award are to be presented not oftener than once in two years and the award is to be substantially the net accumulated income from the fund since the time of the last award, after deducting a nominal cost of administration and the cost of the gold medal and one or more bronze replicas.

In addition to the fund, the dies for the medal and the cost of the first medal were presented to the academy by the eleven officers of the American Telephone and Telegraph Company associated with General Carty in the executive management of the Bell System.

My participation in the presentation of this particular medal to this particular recipient gives me great personal satisfaction. Both the man in whose honor the medal was established and to-night's recipient attained great eminence in science and, as men, each was a great admirer of the other, and in the thinking of each was something derived from his friend. For many years, I have been an admirer of both men.

For more than a quarter of a century, General Carty was my leader and my friend. From him I learned more of science and the ways of men than from all others together. It was my pleasure to have part in establishing the medal and award in his honor. The terms of the deed of gift are in consonance with both his catholicity of view as to all fields of science and all manner of men. It reflects likewise his unbounded confidence in the wisdom of the academy in administrating a trust through the years.

Carty was alive when the medal was established and the first draft of the deed of gift was submitted to him. He objected to it because it contained what he thought was a reflection of his known views. He insisted that the academy be given complete freedom in the years ahead to exercise its judgment unhampered in any way by the views or beliefs of a preceding generation.

I strongly suspect that in this he was influenced by his contacts with Dr. Conklin. I know that he would have derived great satisfaction in this award to his friend.

FRANK B. JEWETT

PRESENTATION OF THE HENRY DRAPER MEDAL FOR 1942 TO IRA SPRAGUE BOWEN[3]

MORE than three quarters of a century ago, Huggins, a former Draper medalist, found that the spectra of certain nebulae were composed of sharp isolated bright lines, thus proving that their luminous material is a glowing rarefied gas. Some of the lines were recognized as those of hydrogen, and later others were identified as due to helium and ionized carbon, oxygen and nitrogen, but nearly half of the nebular radiations, including the two strong green lines, could not be matched in any terrestrial source. These mysterious radiations were believed to indicate the presence in the gaseous nebulae of an unknown element "nebulium" and for more than sixty years the nature of "nebulium" remained one of the outstanding problems of physical astronomy with which the ablest spectroscopist had struggled and had failed. It was solved not by an astronomer but by a physicist, Professor Ira Sprague Bowen, of the California Institute of Technology.

Dr. Bowen's dramatic discovery of the nature of "nebulium" was the result of his brilliant analysis based as modern atomic theory, in which two factors contributed to his success. The first of these was the recognition by him that under the condition of extremely low density obtaining in the gaseous nebulae, radiation of energy could take place through transitions between metastable states. For these the mean life of the excited state is so long that even in the most rarefied laboratory sources, the energy is transferred to another atom by collision and no radiation occurs. The second contributing factor was that his laboratory investigations in spectroscopy carried on in collaboration with Millikan furnished the data which enabled him to determine the energy states for certain of the lighter elements known to be present in the nebulae. He found that the two strong green radiations and one in the blue could be accounted for by transitions between metastable states in doubly ionized oxygen. The familiar pair in the ultraviolet and a line in the red had a like origin in ionized oxygen while the strong red pair was due to similar transitions in ionized nitrogen. Thus "nebulium," the mystery of half a century, turned out to be the two elements forming the chief constituents of the air we breathe.

This initial success with the origin of the chief nebular lines was followed immediately by his identification of a number of fainter ones which had been recorded in the spectra of these objects. Later when opportunity offered, Dr. Bowen went to the Lick Observatory as Morrison research associate where he undertook a search for still fainter radiations emitted by the nebulae. Largely as the results of ingenious methods introduced by him in the observing technique, he was able to record the faintest lines obtainable with the very efficient equipment selected for this problem. The investigation was signally successful and not only revealed the presence in the nebulae of several elements, in particular iron, magnesium, potassium and calcium, which had not been known to exist in them, but indicated that the chemical composition of the gaseous nebulae does not differ greatly from that of the sun and the stars, a result of great cosmological importance.

The researches of Professor Bowen have not only greatly enriched our knowledge of the chemical constitution of the nebulae, but they have provided the answers to many enigmas concerning the physical processes involved in the emission of their light. He has given us most conclusive explanations of the presence or absence of certain radiations in their spectra and in particular the behavior of different lines emitted in the gaseous envelopes of very high temperature stars, bringing to these problems that brilliant and logical analysis characteristic of all his work. His spectroscopic investigations in the laboratory, moreover, have furnished the data not alone for his own researches on the nebulae but have been utilized by others in the solution of the many spectroscopic problems in the broader field of astrophysics. We are, therefore, indebted to him for some of the most important contributions to astronomical physics in recent times.

In recognition of these remarkable achievements your committee has unanimously recommended the award of the Draper Medal for 1942 to Professor Ira Sprague Bowen. The academy may justly be proud to count him among its members and to honor him by the bestowal of this award.

J. H. MOORE

PRESENTATION OF THE AGASSIZ MEDAL FOR THE YEAR 1942, WITH ACCOMPANYING HONORARIUM OF $300, TO COLUMBUS O'DONNELL ISELIN, II.

I AM going to be a bit reminiscent this evening and recall that over forty years ago when I went up the steps of the Agassiz Museum for the first time, a tall stooped figure had just preceded me, the smart brougham from which he had emerged was in the act of driving off. I followed that figure up the stairway and saw it enter a door marked "A. Agassiz" in bold

[3] Read by Dr. S. A. Mitchell, in the absence of Dr. Moore.

letters. As he went in he turned a little sign from "out" to "in." I turn that same sign when I remember to do so, but I often forget; he never did. I naturally wondered what manner of man this was. I soon found out that the graduate students at that time packed into the museum building held him in mortal dread. Rumor had it that some one once carrying a leaky pail of water with living Necturi for experimental purposes from the cellar to the research laboratory on the fifth floor had gone up the stairs just ahead of him. Being the soul of precision and neatness he began to follow the streak of dirty water and he followed it to the desk of the unfortunate student, to whom he administered a most terrific lecture on the evils of untidiness. The details of this persisted and no doubt grew as the tale was told over and over again. In those days long ago there was no love lost between the museum staff and the professors and instructors in the laboratory belonging to the faculty of arts and sciences. All these were then crowded together in the same building. They have all learned better sense now and realize how the work of each one interdigitates with that of all the others. So at the time of which I speak Mr. Agassiz was a mysterious figure, held in what we should think of to-day as rather ridiculous awe.

A few among us who were interested in the museum soon learned of the wonderful work which he had done in his younger years in invertebrate embryology; his masterly handling of the taxonomy of that most difficult group, the Echini; his pioneer work in the exploration of the deep sea; three careers, each of which would have won him lasting fame, to say nothing of his management of the Calumet and Hekla Mining Company, which provided the funds so generously spent by him in many ways and especially on the unequaled series of illustrated Memoirs, the like of which no institution in America has ever produced.

Unfortunately during the latter years of his life he spent, wasted as we know now, years on the study of coral reefs, years which he might far better have devoted to subjects which he was more competent to work upon. While he describes reefs beyond number, he was unable to draw any generalizations and the data which he gathered have not been very useful to the geologists, although Dr. Stanley Gardiner has made some important deductions from the bottom samples which he gathered.

I early determined to know this man and found him simple, kind and friendly. He was much interested in the boyish trip which some friends of mine and I hatched up for the summer of our sophomore year in the Bahamas, using a sponging schooner to dredge from. He was obviously sincerely interested in what we found, and I remember one sponge over which he was really excited.

I found that regularly at ten o'clock each evening that he was in Cambridge, he would go to the Holly Tree at Harvard Square, famous for its beautifully poached eggs. He would eat two of these, drink a glass of beer and then walk back to his house on Quincy Street. I made bold to meet him there quite casually and after a while often walked home with him. This same habit of taking walks at night led to an amusing incident in Berlin, where Mr. Agassiz had been called to be knighted by the German Emperor with the Order pour le Merite, a distinction rarely accorded to foreigners. One evening just after the great event, it was foggy and he was crossing the river which flows through Berlin, walking along the narrow footpath of the bridge. He fetched up in front of a towering figure in the familiar Feldtgrau uniform. Naturally the officer made no move; neither by the same token did Mr. Agassiz, who was nothing if not hot-tempered and impetuous. After some slight hesitation he reached forward and drew the German officer's sword from its scabbard and dropped it into the river. The effect was exactly the opposite to what he had expected. The officer, who had sworn to defend his sword with his life-blood if necessary, was not as infuriated as he was terror-stricken and dismayed, and before long quite characteristically Mr. Agassiz's heart softened and he promised that as soon as daylight came every possible means should be taken to recover the sword. This naturally was done to the officer's everlasting gratitude.

But I can not ramble on this way forever. I simply wanted to point out, as one of a number of those who remember him, but who are inevitably growing fewer, the sort of man whom Sir John Murray wished to commemorate when this award was established. I also wish to put on record the fact that I can think of no one who could stand as recipient and be more utterly satisfactory to Mr. Agassiz as him whom we honor now. Columbus Iselin began as a young man to explore the deep sea from his own *Atlantis,* and I remember the joy and delight with which Henry Bigelow and I gloated over his first catches of beautifully preserved deep-sea fishes and invertebrates. From those days forward Columbus has proved himself to be a competent investigator. Oh no! more than that, an inspired investigator and an excellent teacher, a painstaking and effective executive, and one whose researches into the dynamics and the circulation of the waters of the ocean and especially of the Gulf Stream, have put him in the forefront of oceanographers of the day. Moreover, he has administered the activities of the Woods Hole Oceanographical Institute with singular distinction, both during peace and during war; this also considering that he followed a predecessor who set a mighty high standard for any one who came after him.

It is therefore a rare distinction for me as a member of the committee which has made this award to ask the president in the name of the academy to hand the Agassiz Medal to Columbus O'Donnell Iselin. I only wish that Mr. Agassiz had lived to know him.

THOMAS BARBOUR

PRESENTATION OF THE DANIEL GIRAUD ELLIOT MEDAL FOR 1935, WITH ACCOMPANYING HONORARIUM OF $200, TO EDWIN H. COLBERT

THE award to Edwin H. Colbert for his "Siwalik Mammals in the American Museum of Natural History" (*Transactions* of the American Philosophical Society, 1935, quarto, x + 401 pp., 198 figures in text, 1 folding map) seems especially timely and appropriate, because just a century earlier Cautley and Falconer published the first of their important contributions on the fossil mammals of India. Since then the field has been ably developed by their successors, especially Lydekker, Pilgrim, Matthew and now Colbert. The latter, after giving an excellent summary and analysis of his predecessors' results, has brought in a wealth of new and significant observations of his own.

Although this work is written in English, the technical portions, albeit through no fault of the author, would be hardly more intelligible to the English-speaking world than Chinese, except for the handful of students who have mastered the technical language of paleontology. This branch of science has inherited a double load of technical words, first from geology, and second from anatomy, besides contributing an enormous and rapidly growing vocabulary of its own. But however technical the author was compelled to be in the descriptive portions of his text, he has succeeded in achieving great clarity in the statement of his more general results, which are of wide interest to students both of mammalian evolution and of intercontinental exchange of faunal elements.

In summarizing the work of his predecessors, the author notes that: "Lithologically the origin of the (Siwalik) series is probably simple, representing increasingly coarse river detritus brought down from a rapidly rising mountain mass. Moreover, there are no great secondary changes to be found in the Siwalik rocks, evidences of automorphism and glaciation being absent. The factor of predominant importance is that of erosion and deposition by rapidly flowing rivers." He sets forth fully the accurate records as to locality and stratigraphic levels which were kept by Barnum Brown when the latter made his collection of fossil mammals for the American Museum in 1922. Brown's work in this field was amazingly extensive and productive, especially in view of the great difficulties of collecting in this super-torrid region.

The main part of Colbert's memoir deals with the description of the fossil mammals, the classification and phylogeny of many of the mammalian families, the migrations of certain mammals to and from India during late Tertiary and Quaternary times.

Among the most remarkable mammals dealt with was *Dissopsalis,* a somewhat wolflike placental carnivore with a remarkably small brain—the last survivor of the Eocene and Oligocene creodonts.

In the section on the horses Colbert's measurements and graphs confirm Matthew's conclusion that the two Siwalik "species" of *Hipparion* grade into each other. He further shows that with regard to their molar patterns these forms were definitely more advanced than the American *Hipparion mohavense* Merriam and *H. gratum* Osborn. From this fact and from the complete absence in the known record in Europe of ancestral *Hipparions* of earlier date, Colbert favors the view that these forms originated in North America and spread to India during the lower Pliocene.

The ten species of Siwalik rhinoceroses are distributed under five genera, of which *Gaindatherium* Colbert is more primitive in many features than the existing *Rhinoceros indicus.* It is also intermediate between the latter and the very primitive and older *Caenopus.* Colbert applies and extends D'Arcy Thompson's method by projecting the drawings of several rhinoceros skulls against a grid of coordinates; in a sequence of four rhinoceros skulls the coordinates become progressively distorted in several directions, indicating differential emphasis of certain features.

One of the most notable parts of the memoir deals with the fossil pigs of India, which branched into fifteen genera and numerous species. Colbert divides them into six groups and traces several phyletic lines through the lower, middle and upper Siwaliks. In one of them, *Conohyus,* the posterior premolars developed great conical crowns for smashing and cutting the food. In another, *Listriodon,* each molar bore two cross-crests and thus convergently resembled a tapir's molars. In still another, *Sus falconeri,* the skull is already highly peculiar and needs only the final stage to complete its transformation into that of the African wart hog (*Phacochoerus africanus*).

In describing the fossil Indian hippopotami Colbert quotes the remarkable suggestion of C. W. Andrews that the hippopotami, usually supposed to be related to the pigs, may have been derived from some of the anthracotheres, especially the Siwalik *Merycopotamus.* Colbert gives a thorough analysis and comes to a conservative conclusion but leaves a strong case for the reality of Andrews's interpretation of the evidence.

The descriptive section ends with an excellent analysis of the twenty genera and numerous species of fossil giraffes centering in the Siwaliks. Colbert divides them into three main series: The first and

most primitive being represented by the living okapi of the Belgian Congo, the second by the typical giraffes, the third by such massive giants as *Sivatherium,* whose skull bore huge branching bony "horns."

In the closing analysis on the migration of certain mammals to and from the Siwaliks we see India as at the crossroads, exchanging mammals with Europe and Africa on the one hand and with Asia and North America on the other.

In view of the merits of this work mentioned above, as well as others, the committee has unanimously recommended the award of the Daniel Giraud Elliot medal and honorarium for 1935 to Edwin H. Colbert.

WILLIAM K. GREGORY

PRESENTATION OF THE DANIEL GIRAUD ELLIOT MEDAL FOR 1936, WITH ACCOMPANYING HONORARIUM OF $200, TO ROBERT CUSHMAN MURPHY[4]

FEW writers have had a more prolonged and varied preparation for their task than Dr. Robert Cushman Murphy as author of the "Oceanic Birds of South America." Soon after graduating from Brown, Dr. Murphy shipped aboard the whaling brig *Daisy* on a voyage of nearly a year's duration in the South Atlantic. For the longer part of this period he was associated with birds of the high seas, pulling an oar with the best of the shearwaters and other pelagic species; but for four months he lived on the island of South Georgia. There he obtained the rudiments of a course in South American littoral ornithology. Penguins, albatrosses and other species little known on their breeding grounds were his teachers, but the day was to follow when he would become their monographer.

Several years later, Dr. Murphy passed six months among the bird islands of the Humboldt Current off the coast of Peru. Here, in the world's greatest demonstration of certain phases of bird-life, his education in the ways of marine birds and the factors governing their distribution were still further advanced. In 1924 he returned to this region and extended his studies to the coast of Ecuador.

In these three productive expeditions, Murphy found the field in ornithology in which he has distinguished himself, and when opportunity offered for the formal pursuit of his researches he was equipped to embrace it. Meanwhile, the American Museum of Natural History, under the patronage of Messrs. Brewster and Sanford, commissioned R. H. Beck to collect the marine and littoral birds of South America from Peru to Pará, including Cape Horn and the Falkland Islands. This master of his profession was in the field for four-and-a-half years securing 7,853 specimens, each one a potential source of original information. Murphy was the one man qualified by experience, training, and desire to interpret this collection. Fortunately, he was now on the American Museum's staff. With most of the species represented, he was familiar in life; and he had visited a large part of the area whence they came. Thus his field-studies, added to Beck's collections, made the ideal laboratory combination. With it was included a thorough review of all pertinent literature. Several years were required to digest the whole and present the resulting facts and conclusions in two eminently readable volumes of objective and subjective ornithology.

To the systematic treatment of all the forms concerned, there was added an exposition of Murphy's discovery that oceanic birds are subject to the same kind of environmental control as seals, sea-turtles and even fish. The part played in distribution by the temperature of water as well as air, the influence of wind and of currents and the effects of insular isolation are also considered. Full biographies, when available, are given with each species, and long-standing biologic problems like that presented by the confusing relations of the steamer ducks are satisfactorily treated. All this, and more, is set forth in the 1,245 quarto pages entitled "Oceanic Birds of South America," forming a work of such high merit that, *Mr. President:* The committee has recommended the award by the Academy of the Elliot Medal for 1936 to Robert Cushman Murphy as its author.

FRANK M. CHAPMAN

[4] Read by Dr. Ross G. Harrison, in the absence of Dr. Chapman.

PRESENTATION OF THE JOHN J. CARTY MEDAL AND AWARD (MONETARY AWARD $4,000) TO EDWIN GRANT CONKLIN

THE Committee for the Award of the John J. Carty Medal has had an easy and a pleasant task to perform, for once the name of Conklin was suggested as recipient, so appropriate was his selection that there scarce could be a competitor.

In the citation which has been read are indicated many ways in which Edwin Grant Conklin merits this medal and award, but there is another and unique way in which Conklin qualifies. I refer to Carty's friendship and admiration for Conklin which all Carty's close associates attest, and to the influence of Conklin's philosophy on Carty's thinking as indicated by his writings.

Conklin had pointed out that man's future development lay not in the evolution of man as an individual but in the evolution of society—the building of an harmonious body out of cooperating human elements, with man adding to his own power the forces of nature. Carty saw in the telephone system of his

creation the nerve system of that society—his telephone wires and radio channels were the nerves to provide communication among the specialized human elements of the peaceful and efficient social organization yet to be evolved.

In this connection and because of its timeliness, I think you will be interested in hearing a quotation from an unpublished address of John J. Carty in 1923. After referring to Conklin, Carty said:

We are rapidly constructing a wire and radio system of world communications which is destined to become the nervous system of that vast organism or pseudo-organism known as human society. Whether this organism shall be a sane and peaceful one, or whether we are providing it with a nervous system in preparation for a universal brain storm, requires our most serious consideration.

The progress of science is now so rapid that in less than another hundred years man will be endowed with powers of destruction transcending anything heretofore known. Even half a century hence, communications and transportation may be so far advanced that all of the nations of the earth could be drawn into a war at the end of which the whole world might be in chaos.

That such a catastrophe is possible I firmly believe, but that it can be averted I also firmly believe. This can not be done by slowing down our progress in the application of science to material things; but on the contrary we must accelerate our progress in all the physical sciences, for all of the knowledge thus gained will be required in solving the problem presented by man himself as the fundamental unit of that gregarious organism, human society.[1]

Mr. President: The committee for which I speak is happy to have had the opportunity of making a report so enthusiastically accepted by this academy.

O. E. Buckley

OBITUARY

MARY JANE RATHBUN

Dr. Mary Jane Rathbun, honorary associate in zoology at the U. S. National Museum since November, 1915, died at her home in Washington, D. C., on April 4. Funeral services were held in Washington at the home of her nephew, and burial was at her birthplace, Buffalo, N. Y.

Born in Buffalo on June 11, 1860, Miss Rathbun was educated in the schools of that city, and thereafter devoted a long life of service to the Smithsonian Institution and the U. S. National Museum.

Her brother, Richard Rathbun, later to become assistant secretary of the Smithsonian Institution and director of the National Museum, was, in the early 1870's, already launched on a scientific career which had grown out of his interest in fossil animals found in his father's stone quarries in Buffalo. In the summer of 1881, when he was scientific assistant in the U. S. Fish Commission, his sister accompanied him on one of his annual trips to the commission's summer laboratory at Woods Hole, Massachusetts. There her own interest in biological research was stimulated, and she continued to visit Woods Hole for the next three summers. So great was her interest that she worked for the Fish Commission from 1881 to 1884 without compensation. In 1884 she obtained a position as clerk in the Fish Commission, which she held until 1887, when she was appointed by Secretary Spencer F. Baird, of the Smithsonian Institution, to a position as copyist in the Division of Marine Invertebrates of the National Museum. Later she became aid, then assistant curator of this division. After her resignation in 1914, she was appointed honorary associate in zoology, which title she held until her death.

Miss Rathbun worked for many years alone and unaided to build up the Division of Marine Invertebrates to its present high standard of excellence. She instituted a record system upon which others have never been able to improve. It not only is in use in the division to this day, but has been studied and adopted by other divisions of the museum. She also established a systematic catalogue of the thousands of specimens of marine invertebrates handled by the division, whose files contain hundreds of catalogue cards made out by her in longhand during the many years before a typist was available for this work. The division, as it is constituted and operated to-day, continues to rest upon the solid foundation that she built for it.

Because of her enterprise, the collections and correspondence of the division grew to such proportions that it became imperative for her to have assistance in handling them. When she asked for such an assistant, however, she was told that the museum funds would not permit the appointment of another person. It was then that she made the decision which forever after endeared her to her colleagues, and particularly to the man who benefited by her action. Without hesitation, on December 31, 1914, she resigned her position, in order that her salary could be used for paying an assistant. The assistant for whom she thus made place was Dr. Waldo L. Schmitt, who later became curator of the division. He declares that but for this act of sacrifice he might never have embarked upon the career to which he has devoted his life and which has only recently led to his designation as head curator of the Department of Biology at the museum. He deeply regrets that his absence from the country

[1] Address on "World Communications," at The University Club, New York, February 10, 1923.

at this time made it impossible for him to prepare this obituary notice.

Though now resigned from the museum payroll, Miss Rathbun went to work as usual, and continued to serve full time for twenty-five years thereafter. Thus her Government service ended as it began—with devotion to science and without compensation.

Her own special field of interest was the Crustacea, particularly the crabs, both recent and fossil. Her bibliography on these animals embraces 158 titles. Perhaps her most important and best-known works are her four large monographs on the grapsoid, spider, cancroid and oxystomatous crabs of America, published as bulletins of the U. S. National Museum between 1918 and 1937. In 1917 the George Washington University conferred upon her the degree of doctor of philosophy in recognition of her work on the grapsoid crabs.

Miss Rathbun was interested in a number of charities, but her assistance and contributions to worthy enterprises were given quietly and not much was known about them by her colleagues. It is known, however, that for some years after the last war, when life was very difficult in Austria, she contributed to the support of the small daughter of an Austrian scientist who had long been one of her correspondents. It is only to be hoped that her services to that child, who is now a young woman in Nazi Germany, were not in vain.

Aside from her interest in her work, which took up the greater part of her time, Miss Rathbun was interested in both music and the theater. She was a familiar figure at the concerts given in Washington by the Philadelphia and Boston Orchestras until about four years ago, when her health failed to such an extent that she was no longer able to go out.

To those who knew her and worked with her, Miss Rathbun was a staunch friend, an able counselor and a willing guide. With her passing the museum and science have lost a friend whose loyalty and devotion can not soon be duplicated.

LUCILE MCCAIN

U. S. NATIONAL MUSEUM

RECENT DEATHS

DR. HERBERT E. HAWKES, professor of mathematics at Columbia University and dean of the college, died on May 4 at the age of seventy years.

DR. ELLWOOD B. SPEAR, since 1928 manager and director of research of the Vultex Chemical Company, previously a member of the faculty at the Massachusetts Institute of Technology, died on May 1. He was sixty-eight years old.

DR. W. H. A. LEUKEL, agronomist with the Florida Agricultural Experiment Station for the past seventeen years, died on April 27. He is known for his work on Florida grasses and crops.

SCIENTIFIC EVENTS

MUSEUM ATTENDANCE AND THE WAR

THE Museums Council of New York City has issued to its members a statement giving figures of attendance at the museums, botanic garden, zoological park and the New York Public Library of the city for the calendar year 1942, with comparisons for 1941. The accompanying table gives these figures and the percentages of increase and decrease of attendance for eight (out of nineteen reported on) of the more largely attended institutions. It is interesting to note that the only institutions that show increased attendance in 1942 are two private institutions that charge 25 cents admission. The semi-public institutions, supported in part from the tax budget of the city and in part from private funds, are open free to the public daily.

The report as issued attempts no explanation of the falling off of attendance, but it seems reasonable to infer that the decrease was due to one or more causes growing out of the war. The order of the Board of Education of the city prohibiting public-school classes from visiting any outside institution for instruction for the larger part of the year would account for a part of the loss. The attendance of classes in normal times adds something, of course, to the figure of total museum attendance. The institutions in the table are arranged in the order of percentage of gain or loss of attendance.

ATTENDANCE AT NEW YORK CITY MUSEUMS, 1941 AND 1942

	Attendance 1941	Attendance 1942	Change	Per cent. of change
Increase:				
1. N. Y. Museum of Science and Industry	360,771	414,410	53,639	+15
2. Museum of Modern Art	274,070	279,417	5,347	+ 2
Decrease:				
1. N. Y. Zoological Park	3,320,313	2,319,052	1,001,261	−32
2. Brooklyn Museum	523,856	381,772	142,084	−27
3. New York Public Library	3,331,309	2,772,419	558,890	−17
4. American Museum of Natural History	1,618,765	1,388,561	230,204	−14
5. Metropolitan Museum of Art ..	1,028,950	896,466	123,484	−13
6. Brooklyn Botanic Garden	1,753,381	1,660,046	93,335	− 5

THE AMERICAN COORDINATING COMMITTEE ON CORROSION

THE fifth annual meeting of the American Coordinating Committee on Corrosion was held on April 10 in Pittsburgh, coincident with a one-day symposium on corrosion problems sponsored by the Corrosion Division of the Electrochemical Society, meeting in Pittsburgh on April 8, 9 and 10. Dr. R. B. Mears was elected committee chairman for 1943–44, F. L. LaQue was named vice-chairman and Dr. G. H. Young was re-elected secretary-treasurer. The headquarters are at the Mellon Institute in Pittsburgh.

The committee was organized five years ago to coordinate research activities in this field, and is patterned after similar organizations abroad. As its first contribution, it undertook to survey existing corrosion investigations in this country. Information report forms were submitted to some 600 individuals and companies, through the executive offices of the member organizations of the committee. From the data thus accumulated there was issued in 1940 a confidential Directory of Corrosion Investigators and a classified list of subjects, which was sent to all persons officially listed in the directory. This directory has since been expanded to include additional investigators and to broaden its subject classification. A new revision is planned for 1943.

The committee is at present composed of official delegates from the American Foundrymen's Association, the American Gas Association, the American Institute of Chemical Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Society for Metals, the American Society of Refrigerating Engineers, the American Society for Testing Materials, the American Water Works Association, the American Welding Society, the Armour Research Foundation, the Battelle Memorial Institute, the Electrochemical Society, the Mellon Institute of Industrial Research, the National Bureau of Standards, the National District Heating Association, the National Research Council and the Society of Automotive Engineers. In addition, the American Association for the Advancement of Science and the Canadian National Research Council were elected to membership.

THE BROOKLYN BOTANIC GARDEN

THE thirty-second annual report of the Brooklyn Botanic Garden, just published, records the fact that almost every activity of the garden during 1942 has been determined or modified by the attack on Pearl Harbor and the events that followed. Several pages of the report are devoted to the wartime activities of the garden and its many cooperations with national, state and local agencies. These include extensive victory garden work, with classes and lectures, the maintenance of a model victory garden, wide-spread service through the bureau of public information and the publication and distribution of leaflets on vegetable gardening. More than 125 trees and shrubs and quantities of herbaceous material have been contributed for planting at army camps, nearly 230 books were contributed for the libraries maintained by the United Service Organizations and other agencies, and nearly $5,000 of war stamps and bonds have been purchased by 60 employees. Members of the Kings County War Savings Staff were given permits to sell stamps and bonds in the garden, and the Office of Civilian Defense, with a permit for a table in the garden, enrolled volunteers in twelve different war services, including blood donors, nurses' aids, etc.

Flowers were sent weekly to the Naval Hospital near the Brooklyn Navy Yard; Camp Upton, L. I., was supplied with more than 2,000 ornamental plants for the camp gardens, ornamental plants were supplied to the Service Club Library at Fort Hamilton, about two tons of scrap metal were turned in, and the Office of War Information was given information on the proposed utilization for food of native wild plants of various European countries.

The report includes records of progress in investigation in plant diseases, plant breeding and other aspects of botany, the distribution to more than 600 schools, in every borough of Greater New York, of nearly 1,316,000 packets of seeds to children for planting in school and home gardens, and the attendance of more than 59,500 at classes and lectures during the year, with a registration of nearly 1,300 adults. The registered attendance at the garden for the year 1942 was 1,660,046.

THE RADCLIFFE CHAPTER OF THE SOCIETY OF THE SIGMA XI

THE establishment of a Radcliffe Chapter of the Society of the Sigma Xi has met with some delay because of the unique conditions prevalent in the college. Although its administration is separate from that of Harvard University, all instructors and professors are members of the Harvard faculty and many are members of the Harvard Chapter.

Fifty-nine science instructors and professors teaching at both institutions signed the petition for the chapter on March 24, 1942. It was granted at the forty-third annual convention of the national organization on December 29. Formal installation at Radcliffe College took place on April 15.

Professor Harlow Shapley, national president, and Professor Edward Ellery, past-president and president at the time the petition was granted, were the installing officers. The ceremonies were less formal than is usual on such occasions. Following a tea in Byerly Hall, the science building, the petitioners and

delegates assembled in the Ghirlandajo Room of Agassiz House, where the installing officers spoke briefly on the significance of the society and its major activities, especially of its national lectureships and publications.

Officers were elected as follows: *President,* Dr. Cecilia Payne-Gaposchkin; *Vice-president,* Dr. Elizabeth Deichmann; *Member of the Executive Committee,* Dr. Ytte Muus, and *Secretary-Treasurer,* Dr. Dorrit Hoffleit, all members of the Harvard Chapter. Professors F. M. Carpenter, Grinnell Jones, E. A. Hooton, H. R. Mimno and D. S. Whittlesey were elected members of the committee on membership of the Radcliffe Chapter. The charter was then presented by National President Shapley to Chapter President Payne-Gaposchkin.

In the evening over a hundred members, delegates and guests of the chapter, including Radcliffe graduate students in scientific fields, were entertained at the college. Dr. F. L. Hisaw acted as toastmaster. Dr. Shapley pointed out that this year marks several important scientific anniversaries—the one hundredth anniversary of Harvard College Observatory, the two hundredth of the birth of Thomas Jefferson, the three hundredth of Newton's and the four hundredth of the death of Copernicus. He spoke mainly on various activities for the promotion of science.

The principal address of the evening was given by Dr. Cecilia Payne-Gaposchkin, who spoke on "The Scholar and the World."

DORRIT HOFFLEIT,
Secretary-Treasurer

POSITIONS WITH THE NAVY

THE Navy needs capable men for staff duties in the administration of occupied areas of foreign lands. Candidates with a background of education and experience in government administration may qualify.

Foreign travel, particularly in the Far East and Southwest Pacific region, is desirable; also a knowledge of the customs, language and character of the people in these areas. Applicants with similar experience and knowledge of other foreign areas will be considered if they meet one or more of the following qualifications:

Administrative experience of an important nature, domestic or foreign, involving government, business, foundations, schools of public administration, etc.

Educational experience in State and Federal governments, university administrators; also teachers in fields of geography, economic and international relations.

Engineering experience: construction of public works, shipping, public utilities, transportation, etc.

Legal training and experience of an important nature indicated by relative importance of position in profession or related field, preferably public service.

Candidates must be in good physical condition and be capable of absorbing intensive instruction in a one-year course in government. Commissions in the U. S. Naval Reserve will be granted immediately and applicants who qualify will be on an active duty status. All educational expenses will be paid by the Navy. Service of these officers will extend beyond the expiration of the war.

Qualified candidates should apply to the nearest Naval Office of Officer Procurement. These offices are located in all major cities.

THE AMERICAN CHEMICAL SOCIETY AND THE KILGORE BILL

IN accordance with information received from the American Chemical Society the directors of the society oppose the establishment of an Office of War Mobilization as proposed in Senator Kilgore's bill. Dr. Charles L. Parsons, secretary of the society, reports that

In the opinion of the directors there is no necessity for the enactment of such legislation now. Their objections can be summarized briefly by stating that these bills confer totalitarian powers that should be entrusted to no human being, and require an omniscience for their intelligent execution which is not to be found on this earth.

The directors believe that the enactment of these bills into law at this time would serve no good purpose in so far as the mobilization of technical resources in the field of chemistry is concerned. The Government now has at its command every resource in the fields of chemistry and chemical engineering.

In support of the position taken by the directors, Dr. Parsons points out that the membership of the society, which includes practically all the leading chemists and chemical engineers of the country organized into 101 local sections, varying in size from 30 to 2,500 each, is solidly behind the war effort. Its publications are described as "a complete key to all that is new in chemical discovery and development." They go to all agencies of the Government engaged in the war effort and in addition they go to all war plants engaged in the war effort which in any way deal with the field of chemistry, and they go to practically all the research laboratories in the United States as well as to all educational institutions with chemical departments.

The chief of the Chemicals and Allied Products Branch of the War Production Board is reported to have stated that "without the publications of the society, the laboratories of our colleges, of our Government and of our industries could not efficiently function. These journals are a contribution to the

success of the war which must not be handicapped or retarded in any way. . . . Without them the technical staffs of the Chemical Warfare Service would be most seriously handicapped in their developmental work."

Senate Bill 607 proposes to set up the following offices: (1) Office of Production and Supply, (2) Office of Manpower Supply, (3) Office of Scientific and Technological Mobilization, and (4) Office of Economic Stabilization. This bill carries an appropriation of $400,000,000 and provides for a director of the Office of War Mobilization and four administrators appointed by the director with the approval of the President, one administrator for each of the four offices the bill would create.

SCIENTIFIC NOTES AND NEWS

THE degree of doctor of science was conferred by the University of Rochester at its ninety-third commencement exercise on May 2 on Dr. Stanhope Bayne-Jones, professor of bacteriology and dean of the School of Medicine of Yale University, on leave as a colonel in the Army Medical Corps, and on Dr. Roger Adams, head of the department of chemistry of the University of Illinois, one of the chemists in charge of chemical warfare research.

AT the ninetieth commencement of the University of Wisconsin on May 29 an honorary degree will be conferred on Dr. Henry F. Helmholz, professor of pediatrics at the Mayo Foundation of the University of Minnesota, head of the section of pediatrics of the Mayo Clinic at Rochester, Minn.

DR. THOMAS E. FRENCH, emeritus professor of engineering drawing at the Ohio State University, has been awarded the Lamme Medal for meritorious achievement in engineering. This medal, going each year to an Ohio State alumnus who has distinguished himself in engineering, is named for its donor, the late Benjamin G. Lamme. Dr. French will receive the award at commencement on June 11.

SIR HENRY HALLETT DALE, president of the Royal Society, has been awarded the Harben Gold Medal of the Royal Institute of Public Health and Hygiene, London.

DR. CLARENCE A. HORN, of Albright College, was elected president of the Pennsylvania Academy of Science at the seventeenth annual meeting in Harrisburg on April 2 and 3. He succeeds Charles E. Mohr, director of education of the Philadelphia Academy of Natural Sciences. Dr. Homer C. Will, Juniata College, was chosen president-elect. Vice-presidents elected were Dr. Bradford Willard, Lehigh University, and Dr. LeRoy K. Henry, the Carnegie Museum. Dr. Edwin G. Conklin, president of the American Philosophical Society, and Dr. C. E. McClung, emeritus professor of zoology of the University of Pennsylvania, acting chairman of the department of zoology of Swarthmore College, were elected honorary members.

THE University of Rochester Chapter of Sigma Xi has elected Dr. E. F. Adolph, *President,* and Dr. R. W. Helmkamp, *Vice-president.* Drs. S. C. Bishop and E. A. Culler have been elected members of the *Executive Committee,* and Drs. R. Goodwin and F. Paul of the *Nominating Committee.* The other officers of the society are Drs. K. E. Mason and M. Huggins, *Executive Committee;* Drs. S. C. Madden, F. L. Haven, H. Gardner and H. Scherp, *Nominating Committee,* and Dr. Charles D. Kochakian, *Secretary-Treasurer.*

PROFESSOR VINCENT DU VIGNEAUD, head of the department of biochemistry of Cornell University Medical College, has been elected chairman of the New York Section of the American Chemical Society. He succeeds Dr. Charles N. Frey, director of research of the Fleischmann Laboratory of Standard Brands, Inc. Dr. Beverly L. Clarke, head of the analytical department of Bell Telephone Laboratories, Inc., has been chosen chairman-elect. Dr. Clarke will serve as vice-chairman until July 1, 1944, when he automatically becomes chairman. At the same meeting Professor Peter Debye, of Cornell University, delivered an address on "Reaction Rates in Solution." A discussion was led by Professor Victor K. LaMer, of Columbia University.

THE title of emeritus has been conferred by Barnard College on Dr. Henry E. Crampton, who recently retired from the chair of zoology.

DR. DOUGLAS JOHNSON, professor of physiography at Columbia University, has been named Newberry professor. He is the fourth head of the department since its foundation in 1866, his predecessors being Professors John Strong Newberry, James Furman Kemp and Charles Peter Berkey.

DR. GRANVILLE A. BENNETT, of the Harvard Medical School, has been appointed professor of pathology and bacteriology at the School of Medicine of the Tulane University of Louisiana.

BRIGADIER GENERAL JAMES STEVENS SIMMONS, A. U. S., director of the Division of Preventive Medicine of the Office of the Surgeon General, U. S. Army, has been appointed lecturer in public health on the staff of the School of Medicine of Yale University.

DR. RUFUS OLDENBURGER, professor of mathematics at the Illinois Institute of Technology, has been

elected a member of the board of directors of the Geographic Society of Chicago.

DR. GEORGE W. HUNTER, III, now on leave from Wesleyan University and serving in the armed forces of the United States, has resigned as assistant professor of biology. Dr. Hunter received a commission as captain in the Sanitary Corps in April, last year. In January he was promoted to the rank of major. Since entering the service, he has been detailed to duty at the Army Medical School, Washington, D. C.

DR. BASSETT MAGUIRE, who joined the staff of the New York Botanical Garden in January as visiting curator, will become curator. He will continue his work on the floras of the Intermountain Region and of Utah and on the taxonomy of the Caryophyllaceae.

LEWIS W. WATERS, vice-president in charge of research and development for General Foods Corporation, New York City, has been appointed to the newly established position of vice-president in charge of scientific relations. Thomas M. Rector, manager of the central laboratories in Hoboken, has been named manager of research and development.

DR. DONALD W. MCKINSTRY, of the department of biochemistry of the Medical School of the West Virginia University, has joined the staff of the Biochemical Research Foundation at Newark, Delaware.

CHARLES F. BOWERS, professor of architectural engineering at Iowa State College, has been commissioned a first lieutenant in the Army Air Forces.

DR. JAMES F. CROW, of the department of zoology of Dartmouth College, has been granted leave of absence to study tropical medicine and parasitology as a fellow on the Markle Foundation, sponsored by the Association of American Medical Colleges. He will complete his work at Tulane University before the beginning of the next regular term in July, at which time he will teach tropical medicine and parasitology in the Dartmouth Medical School in addition to his regular undergraduate courses in genetics and elementary zoology.

DR. DONALD T. RIES, who has been park naturalist at Starved Rock State Park, Utica, Ill., has been granted leave of absence to serve as an entomologist in the Sanitary Corps of the army with the rank of first lieutenant. He has reported for temporary duty pending transfer at Camp Grant, Ill.

DR. A. PARKER has been appointed director of fuel research in the British Department of Scientific and Industrial Research.

DR. SEWALL WRIGHT, Ernest D. Burton distinguished service professor of zoology at the University of Chicago, will deliver from May 6 to May 20 the 1943 spring lectures of the Hitchcock Foundation at the University of California at Berkeley. The general subject of the lectures is "Gene and Organism."

DR. CARL VOEGTLIN, chief of the National Cancer Institute, Bethesda, Md., will deliver the fifth Frank Billings lecture of the Thomas Lewis Gilmer Foundation on "Chemistry of the Carcinogenesis and Tumor Growth" at a meeting of the Institute of Medicine of Chicago to be held at the Palmer House on the evening of May 28.

DR. CHARLES F. KETTERING, of the General Motors Corporation, was the dinner speaker at the two hundred and fifty-fourth meeting of the American Physical Society at the Ohio State University, on April 30 and May 1. The title of his address was "Looking Forward through Research."

PROFESSOR HARRY N. HOLMES, of Oberlin College, president of the American Chemical Society, spoke on April 28 to the section of the society at Iowa State College. The subject of his address was "Strategic Raw Materials and the National Defense."

DR. V. P. SYDENSTRICKER, professor of medicine at the School of Medicine of the University of Georgia, will deliver the eighth and last Harvey Society Lecture of the current series at the New York Academy of Medicine on May 20. He will speak on "Nutrition under Wartime Conditions."

DR. E. D. MERRILL, administrator of the Botanical Collections of Harvard University, delivered on April 19 the annual Sigma Xi lecture at the University of Oklahoma. His subject was "Plants and Civilizations." While at Norman he also conducted a symposium on the work of Rafinesque and gave a popular talk on the history and accomplishments of the Arnold Arboretum for the benefit of the university, the public and the local garden club organizations.

THE three hundred and ninety-seventh meeting of the American Mathematical Society was held at Stanford University on April 24. A session for the reading of contributed papers was held in the morning. By invitation of the program committee, Professor A. E. Taylor, of the University of California at Los Angeles, delivered an address on "Analysis in Complex Banach Spaces." A symposium on Applied Mathematics was held in the afternoon. This was organized by Professor Aristotle D. Michal, of the California Institute of Technology, who was chairman of the symposium. The program consisted of three addresses: "Theory of Suspension Bridges," by Professor S. P. Timoshenko, of Stanford University; "Some Present Non-Linear Problems of the Electrical and Aeronautical Industries," by Dr. E. G. Keller,

of the Lockheed Aircraft Corporation, Burbank, Calif., and "The Limiting Line in Mixed Subsonic and Supersonic Flows of Compressible Fluids," by Dr. Hsue-Shen Tsien, of the California Institute of Technology.

THE Special Libraries Association will meet as part of the second Wartime Conference at the Hotel Pennsylvania, New York, from June 22 to 24. The science-technology group of the association, representing engineering, chemical, rubber, utilities and aeronautical libraries, both institutional and belonging to various firms, will hold its annual meeting at that time.

THE Laboratory of Applied Physiology of Yale University, under the direction of Professor Howard W. Haggard, announces the establishment of a new research unit to be known as the School of Alcohol Studies. This unit will be devoted to social, statistical, educational and juridical studies relating to the problems of alcohol. Professor E. M. Jellinek is director of the school. He will conduct an annual summer session in alcohol education designed for the needs of those engaged in activities in which thorough knowledge of the facts about alcohol problems will be of particular usefulness. The first summer session will be held from July 8 to August 16. A number of fellowships are available. For particulars, address the School of Alcohol Studies, Yale University, New Haven, Conn.

DR. W. W. CHARTERS, of the War Manpower Commission, announces that short summer courses in sanitary engineering are to be given at Alabama Polytechnic Institute, George Washington University, the University of Michigan, the University of Texas, the Polytechnic Institute of Brooklyn, the University of Southern California and Oregon State College.

As reported in *The Times*, London, Sir Andrew Duncan, British Minister of Supply, stated in reply to Major Lyons (Leicester), that the object of the committee set up to report on penicillin was to insure that all available information regarding clinical and chemical trials and methods of production was collected and exchanged, and that everything possible was done to promote the most rapid development. The committee consisted of Arthur Mortimer, Deputy Director of Medical Supplies, Ministry of Supply (*chairman*); and Professor A. Fleming, St. Mary's Hospital; Professor H. W. Florey, School of Pathology, University of Oxford; Professor H. Raistrick, London School of Hygiene; Sir Robert Robinson, the Dyson Perrins Laboratory, University of Oxford; Dr. C. R. Harrington, Medical Research Council; Dr. A. N. Drury, Medical Research Council; Dr. V. D. Allison, Ministry of Health; Professor I. M. Heilbron, University of Cambridge, and Lieutenant-Colonel Sir Russell Wilkinson, military medical adviser, Ministry of Supply, together with representatives of firms engaged in production of penicillin.

DISCUSSION

THE FORMATION OF MOSS PEAT BENEATH TRANSLUCENT PEBBLES IN SEMI-ARID REGIONS OF THE GREAT PLAINS

ON a field trip with the late Dr. F. A. Hayes[1] and Mr. G. A. Avery[2] in the semi-arid Northern Great Plain, in western South Dakota in May, 1941, it was observed that a growth of moss and algae and an accumulation of moss peat, varying from a thin film to about one fourth inch in thickness occur beneath translucent quartz and chalcedony pebbles and small stones which are embedded in the surface of well-drained soils. Such an accumulation was not found beneath opaque pebbles and stones. The discovery provides further evidence that stone fragments on the surface of the soil help to conserve moisture by checking evaporation.

We made a general study of the area in the vicinity where the peat phenomenon was first observed in order to confirm my first impression that the peat occurs only beneath pebbles that freely transmit light. Samples of the moss and peat and of the pebbles under which they were found were collected for further study and for presentation to the Botany and the Conservation and Survey Divisions of the University of Nebraska. During the past year observations of the phenomenon have been extended, by the writer and others, to much of the Northern Great Plains.

The first requisite for the growth of moss and the formation of peat, as already indicated, is the presence of translucent pebbles. These must be in firm contact with, and slightly embedded in the soil and their surfaces must be exposed to sunlight. Short-grass cover or thin stands of grass in semi-arid regions apparently furnish the most favorable habitat for the growth of mosses and for the development of peat. The phenomena gradually becomes less noticeable, under natural conditions, in passing into arid regions on the one hand and into subhumid and humid regions on the other. In arid regions, because of the lack of sufficient moisture to support peat-producing plants,

[1] F. A. Hayes was senior soil scientist, Division of Soil Survey, Bureau of Plant Industry, U. S. Department of Agriculture and professor of soil science, Conservation and Survey Division, University of Nebraska.

[2] G. A. Avery is associate soil technologist, Soil Conservation Service, U. S. Department of Agriculture.

algae replaces mosses. Few observations have as yet been recorded for subhumid and humid regions; but because the more luxuriant vegetation excludes most of the sunlight from the pebbles, cryptogamous plants probably are less abundant.

Further study of the occurrence and the distribution of peat beneath pebbles and of the plants contributing to its formation is indicated. Specific names of the plants have not yet been determined.

The term "pebble peat" is suggested for the phenomenon described. As yet no mention of the phenomenon has been found in the literature.

B. H. WILLIAMS

DIVISION OF SOIL SURVEY,
BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

BIOLOGICAL SPECIFICITY OF FOLIC ACID

NIELSEN and Elvehjem[1] and Martin[2] have demonstrated the counteracting effect of folic acid concentrates on growth inhibition of rats due to succinylsulfathiazole and sulfaguanidine. These findings, indicating synthesis of folic acid by the intestinal bacteria, are in accord with the findings of Mitchell and Isbell[3] on synthesis of this substance by rat intestinal flora.

Recent investigation of folic acid concentrates in our laboratory has indicated that they can not be regarded as biologically pure, unless this fact has been demonstrated. Two significant impurities may be present, namely, xanthopterin and *p*-aminobenzoic acid. The amount of xanthopterin present may be several per cent., even in the most potent preparation yet tested on animals.[1] This preparation, which was furnished by our laboratory to Nielsen and Elvehjem (designated 15,000 times as potent as solublized liver), has since been found to contain also 1 per cent. of *p*-aminobenzoic acid.

Since Totter and Day[4] have found that xanthopterin is able to counteract the effect of succinylsulfathiazole on rats, its presence in folic acid concentrates can not safely be neglected. The amount of *p*-aminobenzoic acid present in the potent preparation referred to above is probably not enough to seriously affect the results, but the absence of significant amounts of *p*-aminobenzoic in many folic acid concentrates can not be assumed.

We wish to make clear that the biological identity of folic acid is not questioned by these findings, since in the microbiological test for folic acid using Strept. lactis R both xanthopterin and *p*-aminobenzoic acid are inactive.

HERSCHEL K. MITCHELL

1 E. Nielsen and C. A. Elvehjem, *Jour. Biol. Chem.*, 145: 713, 1942.

2 G. J. Martin, *Proc. Soc. Exp. Biol. and Med.*, 51: 353, 1942.

3 H. K. Mitchell and E. R. Isbell, Univ. of Texas Publication No. 4237, 125, 1942.

4 J. R. Totter and P. L. Day, *Jour. Biol. Chem.*, 147: 257, 1943.

THE KILGORE SENATE BILL

IN the April 23rd issue of SCIENCE, Elliott and Grundfest, the latter national secretary of the American Association of Scientific Workers, highly endorsed the Kilgore Senate Bill 702. They believe with the proponents of this bill that research, development and technology in the United States have no unity of purpose or coordination, and are in a highly disorganized state.

As a matter of fact, the very opposite is true, for never in the history of the country have science and technology been so well organized and coordinated as they are to-day. Striking results have been accomplished by the coordination of governmental agencies, universities, privately endowed institutions, and industrial research laboratories. One may state that the scientific, technological and production men of the United States are doing the greatest job ever undertaken in the history of mankind, namely, converting a great country in less than two years from peacetime pursuits to an all-out war effort. It is safe to say that over 95 per cent. of our scientific and technical manpower and facilities are now highly organized and coordinated to the single end of advancing the war effort, despite the many difficulties involved.

Coordination extends not only to efficient use of materials but to effective mobilization of the human element in research. Our scientists are not only carrying on fundamental and exploratory research at a higher tempo than ever before, but also by applied research providing the materials necessary for the successful prosecution of the war.

In the *Journal of Industrial and Engineering Chemistry* (35: 385, 1943) there is a statement on "Scientific Regimentation" as implied by the Kilgore bill, by Walter J. Murphy.

"The very wording of the 'Declaration of Policy' constitutes a direct insult to the scientific minds of this country and is contrary to the actual facts, as any unbiased study will clearly show.

"We do not have 'an unassembled and uncoordinated state of information concerning existing scientific and technical resources'; we do know that there is no lack of 'an adequate appraisal'; the war effort is not suffering because of 'unplanned and improvident training, development, and use of scientific and technical personnel, resources, and facilities in relation to the national need,' with the exception of the policy of drafting badly needed technically trained manpower into the armed forces."

From time to time our attention is directed toward the super-coordination of science, technology and in-

dustry in Germany as if it were a shining light toward which we should direct our footsteps. This very regimentation of science, technology and industry will prove that nation's undoing. By enforcing regimentation Germany has frozen her scientific and technical assets. As a result she will lose the war because she has destroyed the freedom and competitive spirit which is fundamental to research and on which her ultimate survival depends. We should not make the same blunder by enactment of the Kilgore bill.

The passage of Senate Bill 702 to establish the Office of Scientific and Technological Mobilization would be exceedingly detrimental if not disastrous to the war effort. My convictions are based on the following:

Practically every laboratory in the nation is in the service of the government. These laboratories are headed and staffed by specialists in their particular fields, whether in universities, colleges, research foundations, or operated by individuals and corporations. It is unnecessary for the government to take them over as their programs would be disrupted by any change in management.

Scientists and technologists, though primarily individualists, are submerging personalities in cooperative research of the widest scope, intent only with getting the job done as well and as speedily as possible.

To center the myriad researches now going on in one organization would throw the programs out of gear, causing months or perhaps years of delay while adaptation to the new conditions took place, and during this time we could well lose the war.

As one illustration of scientific and industrial cooperation, individual oil companies, vigorous competitors in peacetime, are now working together, disclosing to each other their processes and technique relating to 100-octane aviation gasoline, lubricants, components of synthetic rubber, toluene for T.N.T. and many other materials produced from petroleum. There are no secrets in the oil industry for the duration.

It is suggested that every scientist, technologist and industrialist carefully study Senate Bills 607 and 702.

GUSTAV EGLOFF

PRESIDENT OF THE AMERICAN
INSTITUTE OF CHEMISTS

QUOTATIONS

SCIENCE AND THE CENSOR

In a joint statement the Army and Navy at last acknowledge that "radar" (a radio detecting and ranging device which spots distant enemy aircraft and which helped to thwart the German attempt to reduce Great Britain to submission) has its uses in war. The press may now presumably tell the public of a device which was patented in half a dozen different forms nearly twenty years ago and described at least in principle in official textbooks. The restrictions by which other military and naval inventions are hedged should also be removed so far as common sense and military discretion permit. By this time, for example, our famous Norden bombsight must have fallen into the hands of the enemy. And so with range-finders and other apparatus captured by the Japanese in the Philippines.

For good reasons of their own the British often release information which is cabled to this country, but which, under the prevailing rules, must be suppressed here. A knowing newspaper man could dig it out of the speeches made by Government spokesmen in response to questions asked in the House of Commons or from articles which have appeared in *Nature, Engineering,* and the *Aeroplane* and which have undoubtedly been approved. But if he prepares an article on his findings he is likely to encounter a granite wall in Washington. Can it be that we know better than the British what may or may not be revealed?

This policy of silence is not limited to strictly military and naval technical news. It includes biology and medicine. It has even happened that statistics given by the President and Cabinet officers in public addresses have been suppressed. Yet the most absurd stories of German technical achievements appear, with the result that the Nazis are credited with far more ingenuity than any people can possess.

It is manifest that the British and American officers of censorship are not coordinated as they should be. It is also manifest that our censors either do not know what is technically new and what is not or that their superiors have given orders that have no justification in the light of military necessity. There has been some disposition of late to take the science writers of the press into the confidence of the War Department, as the recent inspection by invitation of some Eastern war plants indicates. The accounts that the reporters published of what they saw must have been heartening to millions of readers. We want more such articles. A policy of secrecy where there are no secrets can not fail to have a depressing effect on morale. Nothing is worse in time of war than rumor. And the only way to counteract rumor is to publish facts well known to enemy scientists and engineers.—*The New York Times.*

SCIENTIFIC BOOKS

HYDRAULICS

Hydraulics. By GEORGE E. RUSSELL. 5th edition. 468 pp. New York: Henry Holt and Company. 1942.

THIS book is the fifth in descent from a first edition published in 1909. Originally intended to serve as a short elementary text for classroom use, it has grown, through successive editions and two rewritings in large part, to the much more ambitious treatment represented by the present edition. The treatment is presented under fifteen chapters, of which ten deal with the more immediate aspects of the properties and behavior of liquids both at rest and in motion in channels with solid boundaries. The remaining five chapters deal with hydraulic machinery, implying the joint movement of liquids (water usually) and solid boundaries; and involving transfers of energy between the two members of the combination—typically, turbines and pumps.

Although the text is mainly devoted to hydraulics in its literal sense, treatment covering other liquids with high viscosity, such as petroleum oils, and also compressible fluids—gases and vapors—is given to an extent sufficient to enable the student to solve the simpler problems involving such fluids, and also to grasp the essential identity of the basic principles of fluid mechanics in its broader aspects. The five chapters on hydraulic machinery are intended to bring the book into step with modern practice.

The treatment in the first ten chapters is clear, well presented and does not call for mathematical preparation, beyond the simplest applications of the calculus. This self-imposed limitation is something of a handicap in the treatment of certain of the topics, but the treatment thus simplified facilitates the introduction of the student to the subject at an earlier date than under a condition of more rigorous and general treatment.

The chapters on hydraulic machinery present a well-organized elementary treatment of the principles involved, both geometrical and dynamic, with numerous illustrations drawn from recent practice in this field.

The text is well illustrated with 248 figures in the text, of which a number, especially in the chapter on hydraulic machinery, are half tones. There are also some 31 tables giving values of coefficients, etc., together with tables of natural trigonometric functions in the appendix. Most of the chapters are followed by an extended collection of problems illustrative of the subject-matter of the chapter, and aggregating 302 for the book as a whole. There are likewise appended to the subject-matter of the various chapters 76 classified bibliographic references. An appendix gives a brief and elementary discussion of the free vortex, and an explanation of the English and Metric systems of measurement.

The topics chosen for treatment are well selected, the arrangement appears logical, the treatment is clear and sound, and altogether the book should be welcomed as a definite contribution to the field of textbook literature of this subject-matter.

W. F. DURAND

HUMAN REPRODUCTION

The Hormones in Human Reproduction. By GEORGE W. CORNER, Director, Department of Embryology, Carnegie Institution of Washington, Baltimore. 265 pp. 24 plates. 32 figs. Princeton: Princeton University Press. 1942. $2.75.

IN 1942 Dr. Corner delivered the Vanuxem Lectures at Princeton. These lectures, delivered to a general audience, covered the very complex and fascinating assignment of hormones of reproduction. In this volume the author has added much to the material he presented in these lectures. The result is a masterpiece. The subject-matter is presented systematically and accurately and yet so simply and clearly that the reader can not help but be infected by the author's youthful enthusiasm. Even those of us who are intimately engaged in various aspects of the field of internal secretions are carried away with enthusiasm over Dr. Corner's skilful narrative of a detective story involving the innumerable facts accumulated during the past century by many inquisitive scientists. From it we can no doubt all learn how to present involved scientific material in an interesting and convincing style to the layman, but many of us will no doubt discover some, to us, new facts as well.

The subject-matter is developed from the historical, developmental and, in part, comparative scientific point of view beginning with the simplest form, but always in simple terms and with excellent photographic and diagrammatic illustrations of the underlying anatomy. In spite of the elementary and simple presentation the reader is not left with the impression that the remarkable control of the cyclic nature of the processes of reproduction in the female have been completely explained.

The historical background for the isolation of estrogens, progesterone and androgens is given in each case, but naturally, the author writes most feelingly in presenting the development of the scientific methods and results obtained in the isolation of the corpus luteum hormone. He frankly admits that he could not "write this chapter in cool detachment" because of his intimate contact with the work. This chapter

is an excellent lesson in hormone detection and isolation. It is full of examples of disappointments, difficulties, cooperative, national and international, give and take attitude and final success and independent confirmation. Dr. Corner also delights in "endocrine arithmetic," as he calls it. As a result he presents some truly astronomical values on the rate of formation and utilization of progesterone.

Laymen, physicists, chemists, biochemists and biologists alike will find this book exceptionally interesting and valuable.

F. C. Koch

REPORTS

WARTIME ACTIVITIES OF MELLON INSTITUTE, 1942–43

During Mellon Institute's fiscal year ended February 28, 1943, the industrial research staff of the organization has been enlarged to 208 fellows and 187 fellowship assistants—a total increase of 40 for the year. These scientists and engineers have been employed on the 97 industrial fellowships in operation. Forty-four chemically trained women are doing capable work in fellowship laboratory investigations, primarily helping key men. The research demands of the war have indeed given rise to a general expansion of the institute's work.

The donors and members of the institute are exerting every effort to assist the armed forces, federal government agencies and American science and technology in this period of stress. A large number of fellowships are giving their full time to pressing problems induced by warfare. All other fellowships irrespective of name or field have direct or indirect contributory parts in the war effort. Many fellows are serving the nation on emergency advisory or research committees or are participating in field studies of wartime value. Constant technical aid is being furnished to the War Production Board, the Rubber Reserve Company, the National Defense Research Committee and the War Metallurgy Committee of the National Academy of Sciences. In consequence silence must be maintained during war regarding the nature, scope and results of most of the institute's industrial research programs. During the fiscal year—March 1, 1942, to March 1, 1943—the institute has expended $1,520,333 in conductng its various pure and applied science projects. These facts are set forth in the thirtieth annual report of the director, Dr. E. R. Weidlein, to the trustees of the institution.

The interest of the institute's department of research in pure chemistry in cinchona alkaloids has naturally led to investigations relating to synthetic anti-malarials. Apart from any socio-economic significance attached to the normal prevalence of malaria —an estimated one third of the population of the world is subjected to this disease—the gravity of the problem of coping with the malady in many military campaigns renders urgent the discovery of more effectual measures of control. Occupation by the Japanese of those regions in the Far East normally producing the bulk of the world's supply of quinine has made it even more imperative that research on synthetic antimalarials be extended. The department is carrying on a program comprehending various series of compounds for appraisal in malaria therapy. These studies involve in part simple heterocyclic nuclei structurally akin to the cinchona alkaloids and also compounds not so related. Certain Guatemalan plants esteemed locally in the treatment of malaria are being investigated chemically and pharmacologically.

In concluding for the time being researches on the cinchona alkaloids a number of ethers of hydroxyethylapocupreine have been prepared for comparison of their chemical and pharmacological properties with the qualities of the corresponding ethers of 6′-(β-thiolethyl) apocupreine. An innovation in building up certain members of the series of polyhydroxyalkyl ethers of apocupreine, and of other phenolic substances, was the use (as alkylating agents) of the monotosyl esters of the poly-isopropylidene acetals of suitable sugar alcohols. One method for the preparation of hydroxyethylapocupreine has been the hydrolysis of the benzyl group from benzyl-oxyethylapocupreine. It is now known that under the same conditions its homolog, α-phenyl-ethoxyethylapocupreine, is completely hydrolyzed to hydroxyethylapocupreine in approximately one sixth the time with consequent diminution of decomposition to a negligible amount of isolation of very pure hydroxyethylapocupreine in practically quantitative yield.

The statistical study of the use of hydroxyethylapocupreine in the clinical treatment of pneumonia has been suspended in order that the stock of this drug on hand may be utilized for antimalarial investigations. During the past year, however, medical collaborators of the department reported that, after three years of comparing pneumococcic pneumonia cases treated with sulfapyridine, sulfathiazole, sulfadiazine and hydroxyethylapocupreine, the percentage mortality with the latter was nearly the same as with the sulfonamides. Moreover, in contrast with the cases in which sulfa drugs were employed, no toxicity was observed under treatment with hydroxyethylapocupreine. The latter has been shown to be efficacious in the treatment of pneumococcic and staphylococcic infections of the eye.

The pharmacopoeial studies during the year have fallen into three classes. First, have been those quests for facts which inevitably come immediately after the end of a revision period, in consequence of complaints that new standards are too drastic or that new tests or assay procedures are inapplicable to certain lines of manufacture. In general, protests of this nature are usually cared for through easy adjustments of testing methods. Secondly, the national emergency has brought two new sets of problems to the attention of the pharmacopoeial committee of revision occasioned by the failure of foreign sources of supply of important drugs and the need for adjustments in the conservation of sucrose and glycerol. Thirdly, the war has stimulated medical research with particular reference to the requirements in the armed forces for the treatment of burns and traumatic wounds. The laboratory in the institute is also assisting in the revision of the "National Formulary" and the "Pharmaceutical Recipe Book."

The investigations pursued in the Western Pennsylvania Hospital, under subsidy of Mellon Institute, have pertained to burns and wound healing, the mode of action of sulfonamides and the prevention of the common cold. In the work on the treatment of burns attention has been focused on certain polysulfide solutions, one objective being to elucidate the biochemical mechanisms that might explain the improved healing, without infection, characterizing the recovery of several hundred clinical burns already reported. Research on the action of sulfonamide compounds has made use of the colon bacillus. More precise knowledge of the rôle of p-aminobenzoic acid is being sought. The project has involved the mathematical analysis of the growth curves of *B. coli* on a suitable synthetic medium. So far the indications are that a chemical factor (possibly of enzymatic nature) normally originating in bacteria is directly or indirectly responsible for the fission of the cells, that the synthesis of this factor is markedly inhibited by sulfonamides, and that, in the presence of p-aminobenzoic acid, it is possible for the production of this factor to occur. The basic findings of the past six years on the effect of large doses of ascorbic acid on the prevention of the common cold are being subjected to a controlled mass clinical test. The results to date support the original thesis that large doses of this vitamin have an antishocking pharmacological effect, which is quite in contrast to its action where given to correct a nutritional deficiency.

Collaborating with the U. S. Public Health Service, Industrial Hygiene Foundation, whose headquarters are at Mellon Institute, and a group of its member companies are carrying forward a study to assist in reducing sick absenteeism in the industries. The foundation has conducted more plant hygiene surveys than in any previous year; these investigations check on the possible existence of health hazards in the workplaces. If hazards are detected, effectual measures are prescribed for their correction. Besides fostering healthful working conditions, the foundation's plant surveys are proving to be increasingly helpful in advancing harmonious labor relations. The introduction of unfamiliar and new chemicals into manufacturing processes, some with little known effects, is demanding ever greater attention to plant hygiene measures. Meanwhile the dermatoses continue to be the most common of all occupational diseases. The foundation is urging the industries to consult with its specialists regarding the procural of basic information of pertinence and the definition of proper protective measures respecting novel chemical products.

The foundation continued to sustain medical and preventive engineering researches in industrial health by grants to The Saranac Laboratory and the University of Pennsylvania. But studies at the latter institution, as well as at the Harvard School of Public Health, have lately been interrupted by the war. The results of researches in roentgenography at the University of Pennsylvania and on magnesium at The Saranac Laboratory have been published. Another investigation at the University of Pennsylvania pertained to industrial exhaust ventilation.

The foundation's seventh annual meeting, held at the institute on November 10 and 11, was attended by more than 500 industrial executives, health specialists and governmental representatives. There were panels on "Fatigue in Wartime Industry—Hours of Work and Rotation of Shifts," on "More Manpower through the Reduction of Absences" and on "Putting Women, Older Men, and Physically Handicapped to Work." It was reported that the use of aluminum dust in the treatment of silicosis appears to be followed by beneficial results in a significant proportion of cases, chiefly in the amelioration of symptoms and in the increased capacity to work. The campaign to promote proper nutrition for war workers, with emphasis on "pack a lunch that packs a punch," has been stressed as never before and promises to accomplish lasting good. There are now 246 company and association members in the foundation, practically all of which are directly engaged in war production and employ between 2 and 3 million workers.

The number of different industrial fellowships in various fields at the institute are as follows: building technology, 4; ceramics, 7; chemical technology, 31; foods, 8; fuels, 2; hygiene, 4; metallurgy, 7; mineral technology, 4; paper, 2; petroleum, 3; plastics, 12; textiles, 10; miscellaneous, 3. It is timely to point out that investigations of 17 fellowships have related wholly or in part, in one way or another, to synthetic rubbers or rubber replacers of diverse kinds and that

70 research staff members have been carrying on this specific work. Ten fellowships began operation during the year: alumina, cellulosic molding, chemical storage, coal products analysis, coke-plant physical technology, molasses technology, nickel, pencil technology, special lubricants and synthetic rubber hygiene. Four other new fellowships will start soon. During 1942–43 ten fellowships concluded their activities: Cotton Research Foundation, dielectrics, ethanol, Gartex, iodine, meat merchandising, oil cleaner, plate glass, powder metallurgy and special plastics. The Gartex project has been assigned temporarily to the mineral products fellowship; the iodine researches have been intermitted owing to the emergency; the fellowship on powder metallurgy and the multiple industrial fellowship on chain and welding technology have been consolidated with an increase in the personnel.

The investigations on cotton, 1937–43, have left a prominent record of achievement in the field and have opened the door to the future of an important American crop. The research findings have been incorporated in more than fifty publications, including patents. During the past year the multiple fellowship on plate glass technology finished an important study to determine the effect of bomb explosions on glass and other glazing materials. Much information of value in the design, use and protection of windows has been developed and made available to the services and the civilian defense organizations.

During the calendar year 1942, 2 books, 14 bulletins, 33 research papers and 43 other articles appeared from the institute. Twenty-nine United States patents and 17 foreign patents on fellowship inventions were issued. In 1942 investigational results were contributed to the literature by the following fellowships: chemical hygiene, chemical storage, cigaret technology, Cotton Research Foundation, ethanol, food varieties, gas purification, industrial hygiene, meat merchandising, meter, protected metals, Kaolin, refractories, tar distillation and tar synthetics. The department of research in pure chemistry also has several papers to its credit during the past year. *Nutritional Observatory*, a quarterly periodical edited by the staff of the multiple fellowship on food varieties, has entered its fourth volume; this journal has a complimentary mailing list of 26,450.

W. A. Hamor

Mellon Institute of Industrial Research,
University of Pittsburgh

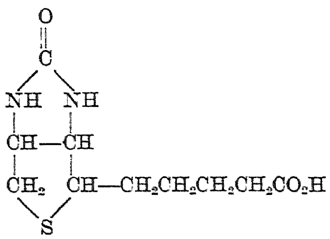
SPECIAL ARTICLES

SYNTHETIC BIOTIN

Biotin has been obtained by a total synthesis in this laboratory, and it has been found to be identical with the natural product. This verifies the structure assigned to biotin.

The isolation of biotin as the methyl ester from egg yolk[1] and vitamin H from liver[2] has been described, and the identity of vitamin H and coenzyme R with biotin has been established.[3]

Results of chemical structure investigations in Europe[4] and in this country[5] gave evidence for a carboxylic acid containing a cyclic urea structure and sulfur in a thioether linkage. Further work in this country,[5, 6, 7] showed biotin to consist of a five-membered urea ring fused to a five-membered cyclic thioether having a normal valeric acid side chain. The essential evidence for the five-membered urea ring in biotin was obtained by hydrolysis to a diamine, which gave a dibenzoquinoxaline derivative and which was reconverted quantitatively to biotin by treatment with phosgene.[5] The essential evidence for the ring containing sulfur and having the side chain was furnished by oxidation of the diamine to adipic acid,[5] by the degradation of biotin to desthiobiotin by hydrogenolysis[6] and by degradation to thiophene valeric acid through a modified Hofmann reaction.[7] The structures of the last two compounds were proved by syntheses involving conventional reactions. Barring molecular rearrangements or other obscure reactions during the degradations, these results justified the conclusion drawn by du Vigneaud and collaborators[6, 7] that biotin has Structure I.



I

[1] Kögl and Tönnis, *Zeits. physiol. Chem.*, 242: 43, 1936.

[2] du Vigneaud, Hofmann, Melville and György, *Jour. Biol. Chem.*, 140: 643, 1941.

[3] György, Melville, Burk and du Vigneaud, Science, 91: 243, 1940; du Vigneaud, Melville, György and Rose, *ibid.*, 92: 62, 1940; György, Rose, Hofmann, Melville and du Vigneaud, *ibid.*, 92: 609, 1940.

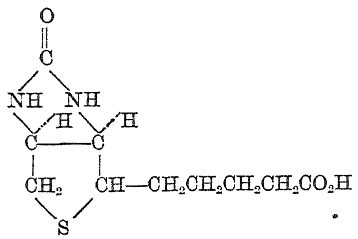
[4] Kögl and Pons, *Zeits. physiol. Chem.*, 269: 61, 1941; Kögl and deMan, *ibid.*, 269: 81, 1941; Kögl, Erxleben and Verbeek, *ibid.*, 276: 63, 1942.

[5] Refer to review papers by du Vigneaud (Science, 96: 455, 1942), and Hofmann ("Advances in Enzymology," Vol. 3, p. 289, 1943. Interscience Publishers, Inc., New York).

[6] du Vigneaud, Melville, Folkers, Wolf, Mozingo, Keresztesy and Harris, *Jour. Biol. Chem.*, 146: 475, 1942.

[7] Melville, Moyer, Hofmann and du Vigneaud, *ibid.*, 146: 487, 1942.

This structure possesses three different asymmetric carbon atoms which normally indicates eight optical isomers or four racemic modifications. However, it is believed from examination of models and reference to the literature[8,9] that two five-membered saturated heterocyclic nuclei fused in this manner can exist only in *cis* forms, as in Structure II.



II

trans Forms of the fused nuclei appear to involve strain which precludes their existence. Apparently, the synthesis of only one compound in which two five-membered rings fused in a *trans* manner through two adjacent atoms has been achieved, namely, *trans*-β-bicyclooctanone,[8] and this is carbocyclic. On this basis, only four isomers existing in two racemic modifications are indicated, and presumably biotin, which is optically active and optically stable,[10] is one of the four.

Any method of synthesis, therefore, has to take these factors into consideration. This we have done. Although the details of procuring best yields of desired intermediates, methods of resolution and other stereochemical problems, etc., are not completely worked out to our satisfaction for a detailed publication as a journal article, we wish to record at this time a comparison of our synthetic product with natural biotin. Synthetic biotin melts at 230–231°, which agrees with the recorded melting point,[11] and is identical with that of a specimen of natural biotin isolated by Dr. J. C. Keresztesy and kindly supplied by him. There is no depression of the melting point of a mixture. The rotation of the synthetic product, $(\alpha)^{25}_{D} + 90.7°$ (C = 2.0, N/10 sodium hydroxide solution) is in agreement also with that of the natural product, $(\alpha)^{25}_{D} + 91.4°$ determined here, and, $(\alpha)^{22}_{D} + 92°$, published[10] previously. The synthetic biotin crystallizes from water in long colorless needles and shows the same general solubility behavior as natural biotin. Its analysis follows: Calcd. for $C_{10}H_{16}N_2O_3S$: C, 49.16; H, 6.60; N, 11.46. Found: C, 49.12; H, 6.47; N, 11.23.

The authors wish to acknowledge the cooperation of Messrs. Glen E. Arth, Robert C. Anderson, Nelson R. Easton and Andrew N. Wilson, and Dr. Dorothea Heyl on the synthesis.

Results of assays on synthetic biotin, determined by Dr. J. L. Stokes, of the microbiology group, with *Lactobacillus arabinosus* No. 17–5 using a described medium,[12] modified to contain nicotinic acid but no biotin, shows that it has a biological activity equal to that of the natural biotin used as a standard.

Bioassays conducted by Dr. G. A. Emerson and Dr. W. H. Ott in the Merck Institute for Therapeutic Research with rats and chicks in which biotin deficiency had been induced by the feeding of egg-white-containing diets demonstrates the fact that the synthetic biotin produces a physiological response identical to that of natural biotin.

The results of the comparison of synthetic with natural biotin establishes their identity and, of course, proves unequivocally the assigned structure[6,7] of biotin.

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[8] Linstead and Meade, *Jour. Chem. Soc.*, 935, 1934; Cook and Linstead, *ibid.*, 946, 1934; *ibid.*, 956, 1934.

[9] Grigsby, Hind, Chanley and Westheimer, *Jour. Am. Chem. Soc.*, 64: 2606, 1942.

[10] Melville, Hofmann and du Vigneaud, SCIENCE, 94: 308, 1941.

[11] du Vigneaud, Hofmann, Melville and Rachele, *Jour. Biol. Chem.*, 140: 763, 1941.

[12] Snell and Wright, *ibid.*, 139: 675, 1941.

PERSISTENCE OF YELLOW FEVER VIRUS IN THE BRAINS OF MONKEYS IMMUNIZED BY CEREBRAL INOCULATION[1]

PERSISTENCE of virus in the body of the host after infection, despite a refractory state to reinfection from without, has been shown to occur in the case of a number of the viruses, and it has been suggested that lasting specific immunity following some virus diseases depends on this persistence. Psittacosis[2] and salivary gland virus infection of guinea pigs[3] are classic examples of diseases in which such conditions have been encountered. Recovery of virus from the

[1] From the Laboratory of the Yellow Fever Research Service, Rio de Janeiro, Brazil. The studies reported in this paper were carried out in the Rio de Janeiro laboratory of the *Serviço de Estudos e Pesquisas sobre a Febre Amarela* (Yellow Fever Research Service) which is maintained jointly by the Ministry of Education and Health of Brazil and the International Health Division of The Rockefeller Foundation.

[2] K. F. Meyer and B. Eddie, *Proc. Soc. Exp. Biol. and Med.*, 30: 483, 1933.

[3] R. Cole and A. G. Kuttner, *Jour. Exp. Med.*, 44: 855, 1926.

brains of animals long after they had been inoculated and found to be refractory to reinoculation has been reported in encephalomyelitis of mice by Theiler,[4] and by Perdrau[5] in rabbits immunized with herpes virus.

Yellow fever vaccine is prepared in this laboratory with active attenuated virus, "17D" strain.[6,7] As a routine control procedure a sample of each lot of vaccine is inoculated into a rhesus monkey by the intracerebral route. Animals so inoculated occasionally show symptoms of central nervous system involvement such as paralysis and muscular incoordinations; even fatal encephalitis has been recorded, though rarely. Usually, however, as in the case of the animals comprising the present study group, the reaction observed is limited to a fever of short duration followed by recovery. Mouse protection tests performed with their blood serum collected thirty days after inoculation show specific neutralizing antibodies.[8]

Attempts were made to recover virus from the brains of some of these monkeys two to five months after inoculation. Three such animals died 63, 93 and 159 days after inoculation, apparently because of generalized tuberculosis. Intracerebral inoculation of mice with suspensions of brain material from these monkeys revealed the presence of an infectious agent capable of producing encephalitis in mice. Strains isolated from all three monkeys were identified immunologically as yellow fever virus. Although the virus in the original brain material was not titrated, a correlation between the period of its persistence and its concentration in the brain is suggested by the study of the mortality and the period of incubation of the inoculated mice. All of them were dead by the ninth and by the thirteenth days, respectively, following inoculation with material from the monkeys which died after sixty-three and ninety-three days. Brain material from the animal dying after 159 days, however, contained only sufficient active virus to produce encephalitis in three of the twelve mice inoculated. These were sacrificed for sub-inoculations shortly after becoming sick on from the eleventh to the thirteenth day.

No virus was recovered from the brains of five additional monkeys which were sacrificed approximately 100 days after inoculation.

An attempt was made in two monkeys, which had been inoculated with 17D virus 161 and 170 days previously, to localize the possibly persisting virus by injecting starch solution intracerebrally 10 days before killing the animals. No virus was isolated from either animal.

The possibility that the tubercle bacillus may play some role in unmasking a latent virus is suggested by the fact, already mentioned, that all three monkeys from which virus was recovered had died in the last stages of generalized tuberculosis.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW METHOD OF DETERMINATION OF THE CHOLINE-ESTERASE ACTIVITY

Chemical methods to determine the activity of choline-esterase are based on measuring the quantity of acetic acid split off from acetylcholine by the enzyme. The manometric determination[1] of carbon dioxide is commonly used. In an alternate procedure the liberated acetic acid is titrated[2] directly with N/100 NaOH. The acetic acid has been determined also by the nephelometric as well as by the electrometric technique. We considered it worth while to compare the results obtained by the manometric and titration methods. The titration was modified as follows: 1–2 cc of human serum were diluted in a wide test-tube with distilled water to give 9 cc. Three drops of phenolphthalein were added and then N/100 NaOH until the solution turned to light red. Thereupon 1 cc of an acetylcholine solution (1:20) was introduced and the tube placed in a thermostat (38° C) for 20 minutes. The liberated acetic acid was then quickly titrated with N/100 NaOH. In comparing the above methods, human serum was used as the carrier of the choline-esterase, and the determinations were carried out simultaneously.

The results were in qualitative agreement when either undialized or dialized blood-serum was used. The same was the case when Prostigmin "Roche" was injected or taken orally before the blood-serum was obtained. Contrary to this, the results differed remarkably when a calcium chloride solution was added to the blood-serum. In the manometric method the calcium chloride appeared to exert a strong inhibitory effect on the choline-esterase, whereas in the titration method no influence of the calcium chloride was observed. Since the Ringer solution used in the manometric procedure contains calcium chloride, the following checks were carried out:

[4] M. Theiler, *Jour. Exp. Med.*, 65: 705, 1937.
[5] J. R. Perdrau, *Jour. Path. and Bact.*, 47: 447, 1938.
[6] M. Theiler and H. H. Smith, *Jour. Exp. Med.*, 65: 767, 1937.
[7] H. H. Smith, H. A. Penna and A. Paoliello, *Am. Jour. Trop. Med.*, 18: 437, 1938.
[8] J. P. Fox, *Jour. Exp. Med.* In press.
[1] R. Ammon, *Arch. ges. Physiol.*, 233: 468, 1933.
[2] Stedman, Stedman and White, *Biochem Jour.*, 27: 1055, 1933, modified by Hall and Lucas, *Jour. of Pharmacol.*, 59: 34, 1937.

	cmm CO_2 liberated in 1 hour
Serum + Ringer solution + Acetylcholine	250
Serum + $NaHCO_3$ + Acetylcholine	325
Serum + Ringer solution + Acetylcholine + $CaCl_2$ (1/500 molar)	146
Serum + $NaHCO_3$ + Acetylcholine + $CaCl_2$ (1/500 molar)	234

It appears that the addition of calcium chloride prevents some of the carbon dioxide from leaving the solution. To prove, that the smaller amount of CO_2 found in the presence of calcium chloride was not due to an inhibitory effect of calcium chloride upon the choline-esterase, but to a methodical error, the acetylcholine was replaced by acetic acid in some determinations:

	cmm CO_2 liberated in 15 minutes
Serum + $NaHCO_3$ + N/100 acetic acid	129
Serum + $NaHCO_3$ + N/100 acetic acid + 0,1 cc $CaCl_2$ molar	120
Serum + $NaHCO_3$ + N/100 acetic acid + 0,2 cc $CaCl_2$ molar	95
Serum + $NaHCO_3$ + N/100 acetic acid + 0,2 cc $CaCl_2$ 1/100 molar	127
Serum + $NaHCO_3$ + N/100 acetic acid + 0,2 cc $CaCl_2$ 1/1000 molar	125

It follows from the above experiments that the titration procedure gives more reliable results, but it has the disadvantage that it can only be used in clear and almost colorless solutions.

Since the manometric method requires a Warburg apparatus we attempted to develop a more rapid procedure for the determination of the activity of choline-esterase in colored solutions. The following was found to be satisfactory: The serum, a $NaHCO_3$ solution and the acetylcholine solution were placed in the outer chamber of a Conway-jar[3] and a N/10 $Ba(OH)_2$-solution in the inner part. The total $Ba(OH)_2$ solution, or 0,5 cc was taken out 40 minutes after the Conway-jar was covered with the glass lid, and the quantity of unreacted $Ba(OH)_2$ was titrated with N/100 acetic acid. The values were satisfactory and in agreement with the results obtained by the titrimetric method mentioned above.

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CHEMICAL STUDIES ON CRYSTALLINE BARIUM ACID HEPARINATE

WE have obtained analytical data for the crystalline barium acid salt of heparin (barium acid heparinate) in comparison with those obtained for the neutral and acid salts of mucoitinsulfuric acid and chondroitinsulfuric acid. The following molar ratio was found for barium acid heparinate. Anhydrohexosamine : anhydrohexuronic acid : SO_3 : Ba = 2.0 : 1.9 : 6.0 : 3.0. Further, N : S : Ba = 2 : 6 : 3. Thus all barium is attached to ester sulfate and the carboxyl group of the uronic acid component is free. Summation (89 per cent.) of the above data, in comparison with the high summation (96 per cent.) obtained for the neutral sodium salt of chondroitinsulfuric acid, does not exclude the possible presence of another constituent. *d*-Glucosamine was identified (as *d*-glucosamine hydrochloride) in the hydrolyzate of the crystalline barium acid heparinate. Sodium heparinate (purified through the crystalline barium acid salt) consumes one mole (per 1,200 equivalent weight) of periodic acid.

The amino group of the *d*-glucosamine component of barium acid heparinate is not acetylated and is not free. Barium acid heparinate loses its anticoagulant potency on repeated crystallization from warm, dilute acetic acid. This change is accompanied by the appearance of a free amino group in the molecule, no sulfate is lost and the material is still stained with toluidine blue. Thus neither sulfate content nor toluidine blue staining power are true criteria of heparin activity.

Crystalline barium acid heparinate is also biologically inactivated by prolonged drying at elevated temperatures and by treatment ("Roche heparin" used in this experiment) with weakly ammoniacal hydrogen peroxide, the latter reaction resulting in appreciable sulfate loss.

Full details will be communicated at a later date.

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[3] E. J. Conway, "Micro-Diffusion Analysis and Volumetric Error."

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SCIENCE NEWS

Science Service, Washington, D. C.

THE DEATH RATE

THE death rate is rising and the pneumonia situation is particularly serious, it appears from the *Statistical Bulletin* of the Metropolitan Life Insurance Company.

A 5.5 per cent. increase in mortality among the company's industrial policy holders was recorded for the first quarter of this year as compared with last year's figure. For the country as a whole, an even greater rise in mortality has probably occurred. In the 90 major cities of the United States there were 9.2 per cent. more deaths reported for the first 13 weeks of 1943 than for the corresponding weeks of 1942. In New York City the death rate so far this year is about 8.5 per cent. higher than for the same period last year.

The war can not be blamed directly for the increase in mortality, it appears. Among the company's industrial policy holders, the rate for deaths from enemy action for the first quarter of 1943 was more than twice that for the first quarter of 1942, but this, it is said, "does not account for the unfavorable turn in mortality for 1943. Most of the rise in rate this year has resulted from other causes."

Pneumonia seems to be the chief factor here. The death rate for the first quarter of 1943 is low compared with rates prior to 1941, but is 21 per cent. higher than last year's rate for the first quarter. Virus pneumonia, also called "atypical pneumonia of unknown etiology," has made up a large proportion of pneumonia cases during the past season, and this type of pneumonia is not affected by sulfa drug treatment.

Seeking to allay the fear that the rise in the pneumonia death rate presages another world-wide flu-pneumonia epidemic, the Metropolitan Life Insurance Company health authorities point out that virus pneumonia is different from both influenza and the pneumonia which accompanied influenza in 1918.

"Nevertheless, the situation needs careful watching. The war effort would be seriously hampered by an increase in pneumonia mortality or even by a continuation of the recent level."

Meningitis mortality also increased sharply in 1943. Disquieting also is the increase in deaths from cancer, diabetes, cerebral hemorrhage, diseases of the coronary arteries and angina pectoris and the chronic heart diseases. With the exception of diabetes, the 1943 death rates for all of these are the highest on record.

Fatal accidents in the home have increased, in spite of the fact that there is very little unemployment and less time is spent in the home now than before the war.

Only cheerful spots on the current health picture are the marked decline in maternal mortality, especially noteworthy in view of the increased birthrate, and the continued decline in the tuberculosis death rate which was 6.8 per cent. less in the first quarter of 1943 than in the same period last year.

INTERIOR HEATING IN METAL WORK

HIGH-FREQUENCY electric field heating in the interior of materials is now used in case-hardening metal machine parts, in the manufacture of plywood and in many other industrial operations. Developed only within the past few years, it is a process similar to the one used by physicians in electro-therapy, in which heat is applied internally to parts of the body. "Penetrating heat" it has sometimes been called by them, to distinguish it from surface heat.

The manufacturing of plywood illustrates how the high-frequency electric field is used. A metal sheet, connected to one terminal of a high-frequency transformer, is placed in the center of a stack of glue-coated veneer sheets two or more feet high. The other terminal is connected to the upper and lower plates of the plywood press itself. Pressure is applied, and at the same time electric energy sent from the middle metal sheet to the plates of the press. The heat sets the glue. Two heavy slabs of plywood may be formed, or many separated plywood boards may result, depending upon the glue application.

In this interior heating, a high-frequency electronic oscillatory system is generally used. It is basically similar to a radio transmitter but usually more powerful. The oscillator is operated on direct current, and gives an alternating current of frequencies from a few cycles to many millions per second, depending upon the setup. In passing from one terminal to the other, much of the electric energy is turned into heat. Case-hardening of small machine parts such as gears and bearings is now being done by a similar electric heating process. In case-hardening only the surface wearing area is hardened. Tinplate, applied to other metals by the electrolytic method, requires polishing. This also is now done by a similar high-frequency electric field process.

Other uses include the heat treatment of tobacco without removing it from the hogshead, and the killing of insects in grains and cereals. Other industrial uses are made of the process, and many additional ones are promised for the near future.

THE 1943 PRODUCTION OF BEET SUGAR

SUGAR-MAKING, which ought to be the sweetest job in the world, is always running into something sour. This year it's the unwillingness of the beet-raising farmers to put in more than two-thirds of the million acres they had expected to plant. Since about a third of our national sugar supply comes from domestically raised beets, this means a reduction of roughly 10 per cent. in the sugar we'll have next year—unless the shipping situation improves to the point where more cane sugar can be brought in from the tropics.

Labor shortage is primarily to blame for the situation. There is a great deal of "stoop labor" involved in raising beets, and since high-wage war-industry plants have

sprung up in practically every beet-raising area in the country, beet-field hands simply aren't to be hired.

Officials of the Department of Agriculture are less worried than the sugar manufacturers. They point out that the acres that will not raise beets this year will raise other crops, all of them needed by the armed forces and by workers on the home front. Indicated replacement crops are mainly potatoes, beans and alfalfa—the latter, of course, to become meat and milk, *via* the farmyard feed rack.

This labor shortage trouble crops up just as the beet-sugar industry had been helped out of another bad fix—a threatened shortage of seed. Thanks to the plant breeders of the Department of Agriculture and state experiment stations, we have become independent of European beet-seed growers, as we are becoming independnt of foreign garden-seed growers.

The story of American sugar-beet seed development is told by Dr. G. H. Coons, of the U. S. Department of Agriculture. Prior to the first World War, although we had something over two thirds of a million acres in sugar-beet production, we relied entirely on European growers for seed. They had the experience, also cheaper labor, so that seemed the best thing to do. There had to be long and anxious negotiations, to get even a trickle of seed through from blockaded Germany. We even had to put up a bond to make a return shipment of the empty gunny-sacks!

At the same time, American sugar-beet fields were under a destructive dual attack here at home. In the West, beets were literally curling up and quitting, under the scourge of a virus disease called curly-top, which crippled their leaves and made them unable to manufacture sugar in the normal way. In the East, there was an almost equally destructive disease called leaf-spot, caused by a fungus.

To meet these and other threats to the Great American Sugar-Bowl, investigators of the Department of Agriculture and the agricultural experiment stations of sugar-beet producing states went to work to develop disease-resistant strains, and to introduce them into cultivation. They succeeded in producing the kinds of new sugar beets they were seeking. No one strain is good for the whole country, for the curly-top-resistant kind good for Western conditions is not immune to the leaf-spot prevalent in the East. Conversely, the leaf-spot-resistant variety can not stand up to curly-top in the West. There are also special strains fitted for local conditions of soil and climate, that are not good outside their particular areas.

In the West home production of seed was undertaken during the 1930's, so that the region as a whole was little disturbed by the cutting off of beet seed imports by the second World War. Growers in the East had let the job of seed production slip back into the hands of European growers, until the total beet seed imports had climbed to around 15,000,000 pounds in 1937, as compared with 13,000,000 pounds grown in the United States—principally in and for the Western fields.

Imports slumped heavily during the first part of the war, though substantial quantities still came in until 1941, since when practically no seed has been received from abroad. Domestically produced seed, however, after a slump from well over 13,000,000 pounds in 1938 and 1939 to not much more than half that in 1940, has now gone up to the hitherto unapproached peak of 18,000,000 pounds.—Frank Thone.

ITEMS

The comet discovered this spring by Miss L. Oterma, of Finland, is increasing in brightness. When first seen on April 8 at the Turku Observatory, the comet was recorded to be of the fifteenth magnitude. Recent observations agree that it is now of the ninth magnitude. The new data were relayed to Harvard College Observatory. Early reports showed the comet in the constellation of Virgo, and moving slowly westward. Dr. Otto Struve, director of the Yerkes Observatory, Williams Bay, Wis., reports that on April 30, at 10:42 P.M., the comet's right ascension was 12 hours, 9 minutes, 58 seconds, and its declination plus 2 degrees, 25 minutes, 10 seconds. On May 2 at 10:45 P.M., the comet's right ascension was 12 hours, 8 minutes, and 13 seconds, while its declination was plus 2 degrees, 28 minutes, 57 seconds.

The discovery of new ore deposits of the rare metal tantalum in New Mexico, which promise high productivity, is welcome news to war manufacturers who use this metal and its compounds. Tantalum's first commercial use was in electric lamps, then it jumped into prominence by its use in radio tubes. Because of its power to resist corrosion, it is used in surgical and dental instruments, electrical contacts, pump and valve parts and temperature control apparatus. Carbides of tantalum are used in wire-drawing dies, steel-cutting tools, wear-resistant parts of machines, and in dies for cold-nosing artillery shells. Although tantalum ore has been mined in Wyoming, South Dakota and New Mexico, the principal source has been abroad. The new deposit, if it meets expectations, may supply the principal needs.

A method for storing fragments of nerves for future use as grafts, somewhat as blood is now stored for future use, was announced by Dr. Paul Weiss, of Chicago, at the meeting of the American Neurological Association. The nerve fragments can be stored indefinitely without losing their effectiveness as grafts. They are frozen at 150 degrees below zero Centigrade, dehydrated in a high vacuum, sealed in and stored in the dry condition. They are rehydrated before use. "This treatment," Dr. Weiss said, "leaves the histological, biophysical and biochemical properties of the nerve essentially unharmed. When grafted, such nerves are readily and fully pervaded by regenerating nerve fibers, much as if they were living." Sleeves of fresh or frozen-dried arteries are another aid to the neurosurgeon. "With their aid, nerve stumps can be spliced without being sewed together and "practically ideal nerve regeneration has been obtained," Dr. Weiss reported.

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THE CONSTITUTION OF PROTOPLASM[1]

By Dr. ALBERT CLAUDE

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AMONG the variety of elements which partake in the constitution of the cell, the nucleus is the largest single body and the one which has lent itself to the most successful investigation. The nucleus was seen as early as 1781 by Fontana, but it was not until the principles of the cell theory were established by Schwann, Remak and Virchow that its role in cell economy could take its full significance. With Flemming, Strasburger and van Beneden began a series of brilliant investigations on the nucleus, which culminated in the discovery of the phenomenon of mitosis and the demonstration of the unique role which the chromosomes assume in heredity. The success met with in the study of the nucleus was undoubtedly due to the circumstance that its structures were able to withstand the action of the fixatives which had come into use during the nineteenth century. This typical resistance of the nucleus to these agents and the nuclear affinity for basic dyes can in turn be traced to a substance present in abundance in all nuclei and segregated in the chromosomes during division, namely, thymonucleic acid.

The usual fixatives which had proved eminently suitable for the preservation of the nuclear framework destroyed the cytoplasmic structures, an effect due chiefly to the high concentration of acids and of alcohol which they contained. The artefacts so produced gave rise to erroneous views on the organization of protoplasm, such as the reticular and the froth theories. The outstanding advance in the study of cytoplasm came with the work of Altmann and his followers, who recognized the destructive action of acids and introduced bichromate as a fixative. This improve-

[1] Paper presented at the Gibson Island Conferences of the American Association for the Advancement of Science, Gibson Island, August 21, 1942.

ment in technique had the advantage of preserving most of the cytoplasmic inclusions and was responsible for the discovery of mitochondria. In the light of modern cytological studies, the cytoplasm appears to be essentially composite in nature, consisting of a continuous ground substance, the hyaloplasm, in which are found formed elements morphologically independent and varying widely in size and shape.[2] The morphology and distribution of mitochondria have extensively been studied and the conclusion is that these elements are constant constituents of cytoplasm. Secretory granules in animals and the plastids in plants are differentiated elements related to specialized functions of the cell and concerned with the elaboration of active substances as in the production of proteolytic enzymes in the pancreas, the production and storage of definite food materials such as starch, or the deposition of pigments. The Golgi body also appears to be a constant constituent of the cell, but its morphology, chemical composition and function are still obscure. The cytoplasmic elements just mentioned are large enough to be stained and studied by the usual cytological techniques. Their average diameter is appreciably greater than 0.2 μ, a value which represents approximately the limit in the power of resolution of the ordinary microscope. Visibility of minute objects within the cell can be considerably increased by means of intense lateral illumination as provided in the dark-field microscope. With the latter technique, it can be shown that the living cytoplasm, in addition to the "visible" inclusions, contains numerous highly refringent bodies of extremely small size, which may be at rest or in active Brownian movement. These ultramicroscopic bodies have escaped the attention of cytologists engaged in the study of fixed preparation, but have often been seen by students of living cells.[3] The chemical composition of the above cytoplasmic structures, their respective functions within the cell, their origin and the genetic relationship between the different classes of granules are problems which have not, and apparently can not be solved by purely microscopical techniques.

During the past few years, this laboratory has been engaged in the mechanical fractionation of normal and tumor cells by means of differential centrifugation, and purified fractions have been obtained from both nuclei and cytoplasm.[4,5,6] The first cell component to be isolated was a particulate substance of cytoplasmic origin which has been described in preceding papers under the provisional term, "small particles."[5] The present paper deals with a further study of this important cell constituent, together with a preliminary account of the isolation and analysis of zymogen granules from the liver and pancreas.[7] The position of the small particles in the organization of protoplasm and their possible relation to mitochondria and zymogen granules will be discussed.

Small particles: The method for the separation of the small particles has been described previously.[4,5] In this method, the cells are broken up and suspended in neutral water and the material is segregated and washed in a high-speed centrifuge. When the purified substance is concentrated in the centrifuge, it appears as a jelly-like pellet which is completely transparent. In this form, the material is not birefringent. Under transmitted light, the substance is somewhat amber in color, a property which is probably due to the large proportion of phospholipids which it contains. By reflected light, the color presented by the purified material may vary, depending on the tissue of origin. When the source of the particles is the liver, the color of the mass may be red or pink. It is usually light brown in chicken tumors and practically colorless in lymphoid tumors and in the pancreas. The unusually bright color exhibited by the liver fraction suggested that part of the purified material might have derived from the red corpuscles, since, in the liver, capillary blood may often form a large portion of the organ. For this reason, the work was repeated on livers which had been perfused prior to extraction. As regards color, yield and chemical composition (Table I), the results of this new series of experiments were identical with those already reported.[5] Therefore, it may be concluded that, in this case, the fraction under study had its origin in the hepatic cell.

When suspended in neutral water, the material forms opalescent preparations which, in the dark-field microscope, appear to be composed of extremely small bodies, highly refringent and in active Brownian movement. The size of the particles has been estimated to range approximately between 50 and 200 mμ in diameter, with no apparent segregation in definite size groups. The isolated particles have been shown to be complex formations in which a nucleoprotein of the ribose type occurs in association with a definite proportion of lipids, especially phospholipids.[4] The chemical composition of this cytoplasmic component is highly characteristic, as indicated by the consistent values obtained on chemical analysis and irrespective of the tissues from which it is prepared. Typical

[2] E. B. Wilson, "The Cell." The Macmillan Company, New York, 1925.

[3] R. Chambers, "General Cytology." The University of Chicago Press, Chicago, 1924.

[4] A. Claude, SCIENCE, 87: 467, 1938; *Proc. Soc. Exp. Biol. Med.*, 39: 398, 1938; SCIENCE, 90: 213, 1939; 91: 77, 1940.

[5] A. Claude, *Symposia on Quantitative Biology*, Cold Spring Harbor, 9: 263, 1941.

[6] A. Claude, *Trans. N. Y. Acad. Sciences*, Series II, 4: 79, 1942.

[7] Details of unpublished experiments, carried out with the collaboration of Dr. C. Auger, will appear in other journals.

values are close to 9 per cent. nitrogen and 1.5 per cent. phosphorus, except in embryos and pancreas, where the total phosphorus amounts to 2.1 per cent. The latter observation is of interest since embryonic tissues and pancreas have been found to be exceptionally rich in ribose nucleic acid. Tables I and II give the average values obtained on analysis of the small particles derived from rat and guinea pig liver (perfused) and from beef pancreas. Small particles of the type described above have been isolated from a great variety of tissues, and the value of 9 per cent. nitrogen appears to be representative for this class of cytoplasmic granules. A study of the available data indicates that the small particles are universal in distribution and that they represent a considerable portion of the cell (at least 10 to 15 per cent. by dry weight). The evidence suggests that the small particles are integral and, without doubt, important components of living protoplasm.

The position which the small particles occupy in the organization of the cell is of particular interest. This point has been under investigation in this laboratory for the past two years, not only with respect to the nature and role of the small particles, but also to the possible relation which may exist between them and other cytoplasmic structures. It was originally stated that the small particles might represent mitochondria or fragments of mitochondria.[4] This suggestion was based on apparent similarities in chemical constitution and on the estimate of the size of mitochondria, as found in the literature.[8] However, it can be shown that, as a rule, the width of mitochondria is appreciably greater than 0.2 μ, whereas the size range for the small particles, as found in our laboratory, appears to be roughly between 50 and 200 mμ in diameter; some particles are occasionally larger.[4] In the guinea pig liver, the red, small particles are definitely submicroscopic, although probably larger than our first estimate of 40 to 60 mμ in diameter.[5] In the spleen, pancreas and the liver of different species, the small particles have been found to be also submicroscopic. However, the sedimentation rate of the substance seems to be influenced by a number of factors, especially by the nature of the solvent and the pH of the solution and further study will be necessary before the actual size of the particles in different tissues can be ascertained. In rat leukemia, particles were found whose size was approximately that of the mitochondria, as seen in the living cells,[5] but a further study of rat leukemia extracts in the high-speed centrifuge showed that the protoplasm of the leukemic cells contained also, like that of other cells, a jelly-like substance composed of submicroscopic units.

[8] E. V. Cowdry, Carnegie Institution of Washington, *Contrib. Embryol.*, 8: 39, 1918.

The following observations on the intracellular segregation of cell constituents in high centrifugal fields indicate that, as a rule, the small particles do not derive from the visible elements of the cell but are undoubtedly part of the so-called ground substance. When hepatic or pancreatic cells are stained by the Altmann-Bensley technique, the zymogen granules and the mitochondria appear colored a vivid red against a diffuse background which contrasts by its slightly purple color. On the other hand, these various cell components can be forced to segregate within the cell by submitting a fragment of tissue to high-speed centrifugation. After 60 minutes at 18,000 × gravity, the different cell constituents are found segregated towards the centrifugal pole in the following order: the glycogen, the mitochondria and secretory granules, the "purple substance" and the Golgi body. The nucleus is at the level of mitrochondria and zymogen granules but above the glycogen. The upper surface of the "purple substance" appears as a straight line boundary. If the centrifugal force is sufficiently great, this boundary may be separated from the centripetal pole of the cell by an area which is clear and seemingly empty. This observation indicates that the apparently homogeneous ground substance contains a particulate, chromophilic component which dissociates itself from the true hyloplasm under moderately high centrifugal force. This "purple substance" which can thus be demonstrated in the cell by the combined techniques of staining and high-speed centrifugation constitutes probably the source of the small particles. This is indicated by the fact that the same color differentiation can be obtained *in vitro*, by staining the isolated fractions, namely, small particles and secretory granules, on the same slide and by the same technique. In this case, the substance of the small particles takes a purple color against the red color of the secretory granules. Staining the tissues with the Regaud technique leads to similar observations, where the sedimentable component of the ground substance (small particles) can be identified by a gray-blue color contrasting with the blue-black color of the secretory granules and mitochondria. Thus, the evidence, so far, indicates that the mass of the small particles does not derive from the grossly visible elements of the cell but constitutes a hitherto unrecognized particulate component of protoplasm, more or less evenly distributed in the fundamental substance and which impart to it, in well-preserved preparations, its staining properties. In order to differentiate the small particles from the other, already identified elements of the cell, it may be convenient in the future to refer to this new component under a descriptive name which would be specific. For this purpose the term *microsome* appears to be the most appropriate. The term microsome, meaning

small body, was applied originally by Hanstein (1880) to any granules, as seen in living protoplasm. The use of the word was progressively narrowed down, being retained as a general term to designate any small granules of undefined nature.[2] Under these conditions, it seems proper to suggest that the term microsome, already familiar to cytologists, should be restricted to designate the small particles exclusively.

Zymogen Granules: The technique for the separation of secretory granules from guinea pig liver has been described in another paper.[5] A new series of experiments on the perfused liver of guinea pigs and the liver of normal rats indicates that the results obtained with this method are highly reproducible, as shown by the very close values obtained on chemical analysis, even in two different species of animal (Table I). Extreme variations in individual experiments were less than 1 per cent. for the nitrogen, less than 4 per cent. for the phosphorus values. Twelve per cent. nitrogen and 1.25 per cent. phosphorus, or values very close to these figures, have been obtained consistently in recent experiments and it may be concluded that they constitute characteristic features of the liver secretory granules. These granules are readily separated from the other liver components, and neutral water can be used in their preparations. In the centrifuge, the liver granules form a loose sediment which is opaque and presents a buff color which resembles that of compressed yeast.

TABLE I

FRACTIONATION OF THE LIVER BY DIFFERENTIAL CENTRIFUGATION: CHEMICAL COMPOSITION OF SMALL PARTICLES AND OF SECRETORY GRANULES. (AVERAGE VALUES FROM 2 EXPERIMENTS)

Animal species	Fraction	N per cent.	P per cent.	C per cent.	H per cent.	S per cent.	Amount obtained (dry weight) per cent.
Guinea Pig	Small Particles	9.08	1.69	56.03	8.23	0.7	7.5
	Secretory Granules	12.08	1.26	54.55	8.09	0.82	4.6
Rat	Small Particles	9.14	1.62	55.44	8.26	0.68	10.0
	Secretory Granules	12.09	1.25	54.45	7.91	0.94	6.6

Separation and purification of zymogen granules from pancreas have presented much greater difficulties, due especially to the presence of a powerful lipase which rapidly attacks the lipid portion of the microsomes and that of the zymogen granules—an action which results in the destruction of their structure and which leads eventually to the denaturation of their proteins. An adequate technique was finally worked out, the details of which will be given in a later paper. This technique is based on a time centrifugation of 30 minutes at 2,000 × gravity. The pancreatic granules so obtained are rapidly destroyed in water, dissociating into a particulate component and an insoluble, highly colored substance. They are fairly well preserved in 0.8 per cent. NaCl solutions at pH 7.5. In the centrifuge, the zymogen granules form a loose and opaque sediment. The color of the material is characteristically yellow and often yellow-green. The chemical composition of the zymogen granules is strikingly similar to that of the liver secretory granules. This resemblance is especially apparent when comparing the results of analysis which are summarized in Tables I and II. In both cases, the value for nitrogen is equal to, or approaches 12 per cent. Moreover, it can be seen that in both liver and pancreas the small particles on the one hand, the secretory and zymogen granules on the other hand, have similar respective values. In both organs, the secretory or zymogen granules have a higher nitrogen and sulfur content, but a lower phosphorus, carbon and hydrogen content than the corresponding small particles. In their gross chemical composition, therefore, the secretory granules, whether from liver or pancreas, are fundamentally alike. The similarity of their elementary structure suggests that these granules represent differentiated members of a single class of cytoplasmic organs which are built on an identical framework, in spite of the specialized and exclusive functions which they may be called upon to perform in organs as dissimilar as the liver and the pancreas.

TABLE II

FRACTIONATION OF BEEF PANCREAS BY DIFFERENTIAL CENTRIFUGATION: CHEMICAL COMPOSITION OF SMALL PARTICLES AND ZYMOGEN GRANULES. (AVERAGE VALUES FROM 5 EXPERIMENTS)

Fraction	N	P	C	H	S
Small Particles	9.16	2.11	57.88	9.06	0.46
Zymogen Granules ...	11.94	1.88	50.39	7.82	0.69

Relation between Microsomes, Mitochondria and Secretory Granules: The studies reported above indicate that, on the basis of general physical properties and elementary chemical composition, there exist two definite classes of cytoplasmic elements, namely, the microsomes and the secretory granules. On the other hand, it has been shown previously that small particles and secretory granules are chemically related, both being complex formations composed of phospholipids and ribonucleoproteins associated in characteristic proportions.[4,5] These findings raise the important problem of the origin of the particulate components of cytoplasm and that of the possible developmental relationship which may exist between the microsomes and the other cytoplasmic structures. The secretory granules from guinea pig liver and from beef pancreas disintegrate spontaneously, when kept

in distilled water, leaving a residue composed of particles which form jelly-like pellets in the centrifuge and which, on analysis, were found to contain about 9 per cent. nitrogen. Thus, the secretory granules seem to contain a substance physically and chemically similar to the so-called "small particles." This observation may suggest that the secretory granules develop from the microsomes or that they have a common origin.

In 1934, Bensley and Hoerr isolated from the liver of guinea pigs a fraction referred to by them as mitochondria.[9] From its physical characteristics the fraction of Bensley and Hoerr seems to correspond to our liver secretory granules. However, inasmuch as the chemical analysis previously reported by these authors is different from our findings, it is impossible to know at the moment whether the two fractions are really identical. Secretory granules are abundant in the guinea pig liver, especially in the fasting animal, where they accumulate and seem to fill the cell completely, and it appears probable that up to the present, mitochondria have not been isolated in a pure or concentrated form, a large part of the so-called "mitochondria" fraction representing probably, to a large extent, mature secretory granules.

Nucleic Acids and Cell Structures: One point which may be discussed in the light of the new findings is that of the origin of the granular substance of cytoplasm. The following considerations suggest that the distribution of nucleic acids in the cell is intimately connected with this problem. Thymonucleic acid has been shown to be exclusively a nuclear constituent. More precisely, it constitutes the distinctive substance of chromosomes. Thanks to the Feulgen technique, it has been possible to show that thymonucleic acid is found nowhere except in the nucleus and that it is present equally in nuclei of animals and plants as well as in homologous formations of more primitive cells such as yeast and bacteria.

Ribose nucleic acid, a close relative of thymonucleic acid, has been known for some time to occur in animal cells. Caspersson and Schultz have shown recently that it is a constituent of nucleoli.[10] Work in this laboratory brought attention to the fact that ribonucleic acid in the cytoplasm is localized on particulate or granular structures. This was first demonstrated for the small particles[4] and more recently for the secretory[5] and zymogen granules. This observation assumes exceptional significance if we consider the fact that, so far, any organic structure which has been found to possess directly the property of self-duplication has also been shown to contain nucleic acid of the one or the other type. The outstanding example is the chromosome. The relation is even more striking when the self-perpetuating unit is not a complex structure but a simple substance such as the autocatalytic nucleoprotein of Stanley. The crystallized viruses of plants are nucleoproteins. Other viruses which have been successfully purified have proved to have a nucleoprotein as a major constituent. This is the case for the Shope papilloma virus.[11] The agent causing Chicken Tumor I has been shown to depend on the integrity of a nucleoprotein for its activity.[12] It appears unlikely that nucleic acid represents no more than an inert substrate whose main purpose is to hold the structure together, as it has often been suggested to be the case in the chromosome. In the light of modern research, it seems probable that nucleic acid plays a fundamental role, perhaps of an enzymatic nature, in the process which enables the structure to reproduce itself.

In the process of cell division, the duplication of chromosomes can be followed under the microscope. There is evidence that the centrioles and certain plastids in plants are reproduced by auto-division.[2] De Vries attempted to show that this was also the case for the tonoplasts. Outside of these isolated cases, there is no satisfactory explanation to account for the perpetuation of cytoplasmic structures, particularly for the increase in granular substance, which must necessarily take place at each mitotic division. Two mechanisms for the perpetuation of these structures are possible: either each element has the power to reproduce its own species or it is being produced by an outside agency which, itself, must be self-perpetuating. The findings that the small particles or microsomes and the secretory granules contain ribonucleic acid suggest that these cytoplasmic constituents, like the other nucleic acid-containing structures, may be endowed with the property of self-duplication. The latter assumption, which should be no more than a working hypothesis, offers a biochemical basis for the view that each vital element which contributes actively to the life of the cell has the power to reproduce its kind. Except for the plant plastids, the experimental proof that other differentiated cytoplasmic granules reproduce in this manner have been elusive and it has often been suggested that these granules are formed *de novo* in the ground substance. The existence of a reservoir of self-perpetuating microsomes from which the specific granules may develop would provide a satisfactory answer to this problem but much research will be needed before this point can be clarified. If our hy-

[9] R. R. Bensley and N. L. Hoerr, *Anat. Rec.*, 60: 449, 1934; R. R. Bensley, *Anat. Rec.*, 69: 34, 1937.

[10] T. Caspersson and J. Schultz, *Proc. Nat. Acad. Sciences*, 26: 507, 1940.

[11] J. W. Beard, A. R. Taylor, D. G. Sharp and D. Beard, *Surgery, Gynecology and Obstetrics*, 74: 509, 1942.

[12] A. Claude and A. Rothen, *Jour. Exp. Med.*, 71: 619, 1940.

pothesis regarding the mode or origin of the microsomes is correct, then these small particles would share with the cell itself, and within the cell, with the chromosomes, the centrioles, the plastids and possibly the tonoplasts, the most general law of living matter, that of genetic continuity. It must be emphasized that the above conception is concerned exclusively with the biochemical aspect of the origin and evolution of the granular substance of the cytoplasm. It does not deny the possibility that the cytoplasmic constituents may come, in the course of their evolution and activity, under the influence of the nucleus.

THE UTILIZATION OF AQUATIC FOOD RESOURCES

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THE food and forage situations in Europe during the past three years have stimulated discussions regarding the availability of certain aquatic plants and animals not now generally used as sources of such material. The utilization of large aquatic plants as forage for animals and the use of both marine and fresh-water plankton as sources of human food have been mentioned. Little has been said, however, about the quantity of these materials found in fresh waters, and a brief consideration of this phase of the problem may be worth while.

Large aquatic plants have been used as forage for cattle in Yugoslavia for many years,[1] and it has recently been reported that they are now being used extensively for the same purpose in Sweden owing to the scarcity of fodder in that country. While these plants have a rather high mineral content (10 to 35 per cent. ash), they contain considerable quantities of nutritious materials; protein makes up 12 to 25 per cent. of the dry weight, fat 1 to 3 per cent. and the remainder of the organic matter consists of carbohydrates, of which crude fiber constitutes 16 to 21 per cent. Using the averages of these percentages of organic matter and assigning 4 calories to each gram of protein and of carbohydrate and 9 calories to each gram of fat, their energy value is about 1,450 calories per pound, dry weight. A mean of 18.5 per cent. of the dry plants consists of crude fiber and the greater part of this may be regarded as indigestible; deducting this part of the carbohydrate would leave an energy value of 1,100 calories per pound for the digestible organic matter in the plants.

Rather large crops of these plants are found in some of the Wisconsin lakes; in Mendota, for example, the annual yield has been estimated at 2,100 tons of air-dry material, or about one ton per acre of the shallow area in which they grow.[2] In Green Lake the crop was estimated at 1,600 pounds per acre, air-dry, in the shallow water zone and the total crop at 1,528 tons. In the soft-water lakes of northern Wisconsin, the yields of large aquatics are much smaller, ranging from 10 to 100 pounds per acre in the vegetated zones.

With respect to the use of plankton for human food, Clarke[3] has discussed this problem from a marine standpoint, referring especially to the plankton crustacea, while Hardy[4] and other authors have called attention to the possibility of using fresh water as well as marine plankton for food; both phytoplankton and zooplankton have been mentioned in some of the communications. It has been pointed out that the chief difficulty is to obtain enough plankton material to warrant the labor involved in collecting it. The smaller organisms which make up the great bulk of the plankton are especially difficult to capture. One author has suggested the use of the tons of plankton collected on the filter beds of cities that filter their water supplies, while others have considered various types of nets. The latter capture only the larger organisms, chiefly zooplankton forms, which usually constitute not more than 10 per cent. of the total plankton and frequently as little as 5 per cent.

Data obtained on Wisconsin lakes show that the dry organic matter of the plankton found in them ranges from a minimum of half a gram in the soft-water lakes to a maximum of 9 grams per cubic meter in some of the hard waters. This minimum in Crystal Lake represented a standing crop of 45 kilograms per hectare (41 pounds per acre), while the maximum in Lake Waubesa indicated a standing crop of 966 kilograms per hectare, or 862 pounds per acre; the live weight of this dry organic matter would be ten times as large, since 90 per cent. or more of the weight of the living organisms consists of water. The mean standing crop of plankton in Lake Waubesa over a period of two years was 242 kilograms per hectare, dry weight, or 216 pounds per acre, of which 49 per cent. consisted of protein, 5 per cent. fat and the

[1] Vilim Mršić, SCIENCE, 83: 391, 1936.

[2] H. W. Rickett, *Trans. Wis. Acad. Sci.*, 20: 501, 1921, and 21: 381, 1924.

[3] SCIENCE, 80: 602, 1939.

[4] *Nature*, 147: 695, 808, and 148: 115, 143, 314, 375, 1942.

remainder was made up of various carbohydrates, including 6 per cent. pentosans and 4 per cent. crude fiber.

Just how much of this plankton material could be harvested and still leave a sufficient number of the organisms to perpetuate the crop and supply sufficient food for larger organisms has not been determined. Likewise the rate of turnover in this standing crop of plankton can not be definitely assessed because it includes a large variety of forms, ranging from bacteria and algae to crustacea and insect larvae, which are diverse in size and in rates of reproduction; in addition growth, multiplication and destruction of the constituent organisms takes place throughout the year. Under favorable conditions, bacteria may multiply several times a day, while algae and protozoa are probably limited to once or perhaps twice a day; the life span of the crustacea ranges from about a week to three months or more, depending chiefly on temperature and food conditions, and that of insect larvae may extend to 8 months or more. Assuming a turnover in this heterogeneous crop of plankton once a month during the year, which is a conservative estimate especially during spring, summer and autumn, would give an annual yield of 2,892 kilograms of dry organic matter per hectare, or 2,580 pounds per acre. It seems probable that the actual annual production is more nearly twice the above amount.

From the standpoint of collecting this plankton, it was found that at least 98 per cent. of it could be obtained by passing the water through a large clarifier type of centrifuge at a rate of 1.5 cubic meters in two hours. The average yield from samples of this size in Lake Waubesa was approximately 5 grams of dry organic matter per cubic meter of water. Assuming the same values for protein, fat and carbohydrate as noted for the large aquatics, the energy value of these 5 grams of plankton would be 20 calories. Thus with an energy requirement of 3,000 calories per person per day, it would take the plankton from 150 cubic meters of water to satisfy this energy demand. To obtain the plankton from this amount of water would require the operation of the centrifuge continuously for a period of 200 hours, or a little more than 8 days, to satisfy the energy required for one day. From this result it is evident that the installation of a large battery of these centrifuges in order to reduce the time of obtaining the desired quantity of this material would not be a profitable investment.

Another difficulty may be mentioned in connection with certain forms included in the phytoplankton and protozoa. While both marine and fresh-water crustacea have been pronounced as "not unpleasant" by those who have eaten them, it seems probable that the verdict would not be so favorable if the smaller plankton organisms were included in the menu because a number of them produce odors and tastes[5] that are not only unpleasant but quite disagreeable under certain conditions. Fresh-water plankton crustacea make up such a small percentage (less than 10 per cent.) of the total crop of plankton that they can not be relied on to contribute greatly to the energy requirement of a person, but they might be used to supplement a sub-standard food ration to a certain extent. They have a high food value, since an average of 52 per cent. of their dry weight consists of protein and 13 per cent. fat. One of these crustaceans, namely Daphnia, is cultured extensively in pools and ponds by fish culturists for food for young fish and there is no apparent reason why they can not be grown in quantities large enough to serve as a supplementary food for man, especially during the more favorable growing seasons in spring, summer and autumn. They are readily preserved for future use by the simple process of drying.

The plankton, either directly or indirectly, makes an important contribution to the food supply of fish; in fact, the menu of fish in one way or another is derived principally from the plankton, the bottom flora and the bottom fauna. Fish, however, are very poor converters of the biota of a lake into nutritious food for man in the form of their own bodies; they are much more easily harvested and much more palatable to man. Their inefficiency as converters is shown by the fact that they constitute less than 3 per cent. of the total weight of the biota in some of the smaller lakes.

As indicated above a turnover once a month in the plankton crop of Lake Waubesa would give an annual yield of 2,592 pounds per acre of dry organic matter, or 25,920 pounds per acre of live organic matter. In control seining on this lake carried out by the Conservation Department, the average annual yield of carp from 1934 to 1939, inclusive, was 278 pounds per acre;[6] in addition the estimated catch of game and pan fish by anglers was 17 pounds per acre in 1938 and 1939, thus making the average fish yield 295 pounds per acre for these six years. This annual yield of fish was only 1.1 per cent. of the estimated annual production of live plankton as indicated above; in other words only one pound of fish per acre was produced annually for every 88 pounds of plankton. It must be remembered also that the bottom flora and fauna are not taken into account in this comparison; if they were included the result would be still more unfavorable for the fish. The weights of these two groups of organisms have not been determined so

[5] G. W. Whipple, "The Microscopy of Drinking Water," New York, 1927.

[6] D. G. Frey, Ph.D. Thesis. 1940.

that no definite ratio can be given for the total biota; the bottom flora and fauna, however, are major sources of food for the fish, especially the larger sizes, while plankton is the chief source during the first two years of life. With such a large surplus of plankton, it seems probable that 50 per cent. of it could be harvested for human food, if desirable and practicable, without decreasing the rate of fish production.

In spite of the fact that the annual production of fish appears unusually low in comparison with the other biological resources of Lake Waubesa, it compares very favorably with the beef production of pasture land, for example, excellent pasture is required to produce 200 to 300 pounds of beef per acre per year. It may be pointed out also that the fish yields in 1938 and 1939 were more than 500 pounds per acre in this lake, with a maximum of 550 pounds per acre in 1939. The latter yield is approximately twice as large as the maximum beef production of first-class pasture land.

OBITUARY

WILLIAM ALBERT SETCHELL

WILLIAM ALBERT SETCHELL, professor emeritus of botany of the University of California, died in Berkeley on April 5, 1943. Had he lived ten days longer he would have reached his seventy-ninth birthday. Professor Setchell was born in Norwich, Connecticut, on April 15, 1864. He graduated from Yale University with the degree of A.B. in 1887. He then entered Harvard University for graduate study and received the degrees of A.M. and Ph.D. at that institution in 1888 and 1890, respectively. He was appointed instructor in biology at Yale in 1891 and remained in that position until 1895, when he was called to a full professorship and headship of the department of botany of the University of California; this he held until his retirement in 1934, after which he became professor emeritus.

In 1920 Dr. Setchell was married to Mrs. Clara Ball Caldwell, who died on September 4, 1934.

Professor Setchell enjoyed membership in several professional societies, but in addition he was honored by election to several organizations of special distinction. He was a fellow of the American Association for the Advancement of Science, of the American Academy of Arts and Sciences, the California Academy of Sciences and the Torrey Botanical Club. He was a member of the National Academy of Sciences, the American Philosophical Society and the Washington Academy of Sciences in this country, and of several distinguished societies abroad. Among these latter were Société Biogéographie, Société Linnéenne de Lyon, Botanical Society of Japan, the Linnaean Society of London and the Kunglig Vetenskaps och Vitterhets Samhället i Göteborg.

In the field of science to which he devoted his life Setchell made a distinguished record. Thoroughly competent though he was in botanical taxonomy in general, his distinction lay in his monumental contributions to algology and especially to marine algology. From the cooperative researches which he carried on through most of his life with the late Professor Nathaniel Lyon Gardner, there resulted in published form several large volumes on the marine algae which are among the most thoroughgoing and impressive in the world. Moreover, he was never a narrow student of taxonomy. He was as much interested in the causes of the geographic distribution of algae as in their orderly classification, and his contributions to our knowledge of the rôle of temperature in the distribution of algae have received world-wide notice. Setchell was one of the early students of plant genetics in this country and inaugurated the fundamental genetical studies on Nicotiana which have since been carried on with distinction by Professors Goodspeed and Clausen.

His versatility in his field of science was paralleled by his general versatility. With the classical background of his college training he combined a flair for writing and speaking in graceful and humorous vein, thus making him a companion sought after by circles of laymen as well as of scientists. His appreciation and critical appraisal of the best in literature and music went far beyond that of most laymen. Through his possession of so many and varied qualities of mind and spirit he gained numerous friends in Europe and in other continents which he visited on several occasions. These friends regarded him with affection as well as respect. Likewise, in this country his friends were legion and he was especially gifted in appealing to young men from every biological field who always surrounded him in numbers. Many a young man in biological work in this country received inspiration and material aid from him, as well as wise counsel and lasting friendship.

Those of us who knew Professor Setchell intimately not only admired his hearty personality, fine learning and expertness with the marine algae, but in addition regarded him as an example of the best in American scholarship and manhood. He was a great algologist, a sturdy American and a loyal and devoted friend. All who knew him will mourn his loss to us.

CHAS. B. LIPMAN

DEPARTMENT OF BOTANY,
UNIVERSITY OF CALIFORNIA

RECENT DEATHS

DR. JAMES EWING, professor of oncology at the Cornell University Medical College and consulting pathologist at Memorial, Roosevelt and New York Hospitals, from 1913 to 1939 director of Memorial Hospital, died on May 16 at the age of seventy-six years.

EDWARD A. WHITE, professor emeritus of floriculture and ornamental horticulture at Cornell University, died on May 13 at the age of seventy years.

DR. CLARA E. SMITH, professor of mathematics at Wellesley College from 1924 until her retirement in 1934, died on May 12. She was seventy-eight years old.

DR. J. LEON LASCOFF, past president of the American Pharmaceutical Association, died on May 4 at the age of seventy-six years.

DR. ALEXANDER P. ANDERSON, botanist and industrial chemist, who maintained a private laboratory at Red Wing, Minn., died on May 7 at the age of eighty years.

DR. WARRINGTON YORKE, F.R.S., Alfred Jones professor of tropical medicine in the University of Liverpool and at the Liverpool School of Tropical Medicine since 1929, died on April 24 at the age of sixty years.

SCIENTIFIC EVENTS

THE FUTURE OF FOOD PRODUCTION IN GREAT BRITAIN

A REORGANIZATION of the British Ministry of Agriculture which would include the setting up of a statutory body, on the lines of the Forestry Commission, for food production and control, free from political controversy, is recommended, according to *The Times*, London, in a report issued by a special committee appointed by the Royal Agricultural Society of England to consider post-war policy.

The members of this committee were Sir Arthur Hazlerigg (chairman), Lord Mildmay of Flete, Lord Cranworth, Sir Merrik Burrell, Sir Roland Burke, Sir George Courthope, M.P., Sir Archibald Weigall and A. H. B. Talbot-Ponsonby. The statutory body, they suggest, should be appointed by the Minister of Agriculture, who would be responsible for it to Parliament. Its main duties would be: (1) To deal with the present work of the Food Ministry; (2) to function as an Imports Board; (3) to stabilize prices and link guaranteed prices to guaranteed wages; and (4) to make sure that the land is farmed well and that the fertility of the soil is not only maintained but in many cases materially increased.

The report urges that, after a complete survey of the land, a definite acreage should be earmarked and set aside for agriculture, and that, so long as this land is so earmarked, no death duties should be levied on it. Land-owners and farmers would naturally have to submit to more control than hitherto under ordinary peace-time conditions.

The committee proposes for each county a special committee with one or more paid executive officers, who would travel round the county and report to their committee, which would deal drastically with cases of bad farming. The committees would have to be carefully chosen from the best landowning and farming interests, and there must be a right of appeal to an impartial tribunal of experts in farming and members with some legal experience.

The change would entail the repeal of part, if not all, of the Agricultural Holdings Act, 1923, and county councils would need new agricultural committees, which would still deal with small-holdings, diseases of animals and agricultural education.

In the reconstruction of the Ministry of Agriculture, provision would have to be made for a recruitment of a special branch of the Civil Service having practical experience of farming. As a first measure the committee recommends that five surveyors of food production, drawn from the ranks of those who have themselves farmed successfully, should be appointed to the staff of the ministry to be graded as first-grade civil servants commanding high salaries.

The whole basis of entry into the ministry and promotion, it is suggested, should be reorganized, and almost every entrant should undergo training to include at least one year's practical work on a farm. He should either take a degree in agriculture at a university or a two-year course at any leading agricultural college, where, after passing an examination such as for a national diploma in agriculture, he could graduate into the ministry.

NEW FELLOWS OF THE ROYAL SOCIETY OF EDINBURGH

IT is announced in *Nature* that the following have been elected ordinary fellows of the Royal Society of Edinburgh: Dr. A. T. Andreasen, principal of the Orissa Medical School, India; A. H. R. Ball, rector of the Royal High School, Edinburgh; J. G. Chalmers, department of chemistry, University of Edinburgh; J. B. Crawford, treasurer of the Bank of Scotland, Edinburgh; Dr. R. G. M. Dakers, Heriot-Watt College, Edinburgh; the Right Hon. William Y. Darling, Lord Provost of the City of Edinburgh; the Right Hon-

orable John Dewar, Baron Forteviot of Dupplin; N. Dobson, Ministry of Agriculture's Veterinary Laboratory, Weybridge, Surrey; Dr. A. Dunbar, Edinburgh; Dr. H. R. Fletcher, government botanist, Edinburgh; Professor R. Fürth, Dewar research fellow, University of Edinburgh; Professor J. H. Gaddum, professor of materia medica, University of Edinburgh; Professor A. C. Hardy, regius professor of natural history, University of Aberdeen; W. B. Hislop, Edinburgh; J. D. Imrie, City Chamberlain, Edinburgh; the Right Hon. Thomas Johnston, Secretary of State for Scotland; D. K. Kevan, Secretary, Ministry of Supply (Timber Control), Edinburgh; Dr. Robert Kirk, Kitchener School of Medicine, Khartoum; C. C. Learmonth, secretary, Merchant Company, Edinburgh; Professor C. H. Lobban, professor of civil engineering, King's College, University of London; Robert Lyon, principal, Edinburgh College of Art; W. W. McClelland, executive officer to the National Committee for the Training of Teachers; G. MacKenzie, general manager, British Linen Bank, Edinburgh; Colonel G. H. G. McLean, Glasgow; Duncan Macnaughton, Edinburgh; Dr. G. C. McVittie, King's College, University of London; Dr. D. M. Morison, Royal Hospital for Sick Children, Edinburgh; Dr. Charles Ockrent, Glasgow; Dr. J. M. Robertson, Gardiner professor of chemistry, University of Glasgow; Dr. W. M. Smart, regius professor of astronomy, University of Glasgow; Dr. W. J. Stuart, consulting surgeon, Royal Infirmary of Edinburgh; J. M. Thomson, secretary, Scottish Education Department; Dr. E. Warhurst, Heriot-Watt College, Edinburgh; Dr. T. S. Westoll, department of geology, University of Aberdeen; Dr. R. W. Wheldon, department of agriculture, University of Durham; H. H. Wood, department of English literature, University of Edinburgh.

THE FOUR HUNDREDTH ANNIVERSARY OF THE DEATH OF COPERNICUS

ADDRESSES by prominent educators, as well as a musical program, will feature exercises which the University of Pennsylvania will conduct in memory of Nicholas Copernicus, the Polish astronomer, in the Irvine Auditorium, Thirty-fourth and Spruce Streets, at 3:30 o'clock on Sunday afternoon, May 23.

The exercises, which will be open to the public, will commemorate the four hundredth anniversary of the death of Copernicus and of the publication of his epochal treatise, "De Revolutionibus Orbium Coelestium." It was in this treatise that Copernicus revolutionized man's concept of his relation to the universe by first developing the theory that the earth was not the center of the universe but revolved around the sun.

Dr. Thomas S. Gates, president of the University of Pennsylvania and a member of the Copernican Quadricentennial National Committee, will preside over the ceremonies and there will be addresses by Dr. Lynn Thorndike, professor of history at Columbia University, and Dr. Charles W. David, professor of history at the University of Pennsylvania.

Selections by the Paderewski Polish Choral Society, under the direction of Dr. Walter Grigaitis, will follow each address, and members of the society in Polish costume will serve as ushers at the exercises.

The Reverend Francis Palecki, rector of St. Hedwig's Church, will give the invocation, and the Reverend J. Clemens Kolb, chaplain of the University of Pennsylvania, will deliver the benediction.

The exercises at the university will form part of a nation-wide tribute to the memory of Copernicus.

In addition to President Gates, members of the Copernican Quadricentennial National Committee of the University of Pennsylvania include Dr. A. Newton Richards, vice-president of the university in charge of medical affairs, and Dr. John R. Kline, professor of mathematics and secretary of the American Mathematical Society.

THE DEPARTMENT OF EXPERIMENTAL BIOLOGY OF THE AMERICAN MUSEUM

THE reorganization of the Department of Experimental Biology of the American Museum of Natural History has been announced by the administration. The name has been changed to the Department of Animal Behavior, and the scientific staff of the department is constituted as follows: Dr. Frank A. Beach, *Chairman and Curator;* Dr. T. C. Schneirla, *Associate Curator;* Lester R. Aronson and Dr. Albert P. Blair, *Assistant Curators;* Miss A. Marie Holz, *Scientific Assistant;* Dr. Libbie H. Hyman, Dr. William Etkin and Dr. Charles M. Breder, Jr., *Research Associates.*

The twofold function of the department is defined as research in animal behavior and the planning of exhibits on the same subject. The orientation of the department's research program, involving a coalescence of field and laboratory methods of investigation, deals with general principles revealed in the behavior of various animal groups. The current investigational program includes studies on invertebrates, fishes, amphibians, birds and mammals. At present a large part of the research of the department is centered about problems of reproductive behavior, and the assistance of the Committee for Research in Problems of Sex, National Research Council, is greatly facilitating this series of studies.

Plans for exhibits designed to illustrate broad principles of animal behavior and to emphasize the evolu-

tion of major reaction patterns have been approved. Such exhibits enrich the visitor's concept of the psychobiological aspects of animal life and increase his perspective and understanding of human behavior.

THE ELECTROCHEMICAL SOCIETY AND THE KILGORE BILL

THE following resolution was adopted unanimously by the Electrochemical Society at its eighty-third meeting, held in Pittsburgh from April 8 to 10:

WHEREAS, It appears that enactment of the Kilgore-Patman Bill S-702, HR2100 for the establishment of an Office of Scientific and Technical Mobilization

(a) Would confuse the war effort by creating at this time a new agency for the direction of the scientific and engineering program which is now so effective in the prosecution of the war and

(b) Might develop in peace-time a gigantic bureaucracy which would impede scientific and technical progress, be it

Resolved, Therefore, that members of the Electrochemical Society be urged to examine this bill and communicate their views on it to their congressmen, and furthermore be it

Resolved, That the Electrochemical Society in convention assembled, express its general opposition to the enactment of any measure which embodies government supervision, regimentation and control of the scientific and technical resources of the nation in peace-time.

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT the annual meeting of the American Academy of Arts and Sciences, held on May 12 at its house, 28 Newbury Street, Boston, the election of twenty-seven fellows was announced:

MATHEMATICAL AND PHYSICAL SCIENCES

Bradley Dewey, Dewey and Almy Chemical Company, Cambridge.
Enrico Fermi, professor of physics, Columbia University.
Philipp Frank, lecturer on physics and mathematics, Harvard University.
Edwin Powell Hubble, astronomer, Mount Wilson Observatory, Pasadena, Calif.
Edwin Herbert Land, president, Polaroid Corporation, Cambridge.
Cecilia Payne-Gaposchkin, astronomer, Harvard College Observatory.
Donald Charles Stockbarger, associate professor of physics, the Massachusetts Institute of Technology.
Hugh Stott Taylor, professor of chemistry, Princeton University.

NATURAL AND PHYSIOLOGICAL SCIENCES

Arlie Vernon Bock, professor of hygiene, Harvard University.
David Bruce Dill, professor of industrial physiology, Harvard University.
Chester Scott Keefer, professor of medicine, Boston University.
Lewis Don Leet, associate professor of geology, Harvard University.
Brenton Reid Lutz, professor of biology, Boston University.

SOCIAL SCIENCES

Augusta Fox Bronner (Mrs. William Healy), director, Judge Baker Guidance Center, Boston.
Ada Louise Comstock, president, Radcliffe College.
Benjamin Morris Selekman, associate professor of business administration, Harvard University.
Payson Sibley Wild, Jr., associate professor of government, Harvard University.
Charles Edward Wyzanski, U. S. district judge for Massachusetts.

THE HUMANITIES

Leonard Bacon, poet and teacher.
Willa Cather, novelist.
Carleton Stevens Coon, associate professor of anthropology, Harvard University.
Angus Dun, dean, Episcopal Theological School, Cambridge.
Hugh O'Neill Hencken, curator of European archeology, Harvard University.
Perry Gilbert Eddy Miller, associate professor of history and literature, Harvard University.
Jean-Joseph Seznec, associate professor of Romance languages and literature, Harvard University.
Randall Thompson, composer and teacher.
Thornton Niven Wilder, novelist and dramatist.

The officers elected for the year 1943–44 were:

President, Harlow Shapley.
Vice-Presidents, Percy W. Bridgman, S. Burt Wolbach, Sidney B. Fay and Fred N. Robinson.
Corresponding Secretary, Abbott Payson Usher.
Recording Secretary, Hudson Hoagland.
Treasurer, Horace S. Ford.
Librarian, Frederick H. Pratt.
Editor, Robert P. Blake.

The Academy voted to award the Rumford Medals to Charles Edward Kenneth Mees, of the Eastman Kodak Company, for his contributions to photography.

SCIENTIFIC NOTES AND NEWS

THE doctorate of science was conferred on May 9 at the commencement exercises of Syracuse University on Dr. William M. Smallwood, professor emeritus of zoology of the university, and on Dr. Charles Hurd, professor of organic chemistry at Northwestern University.

ST. LAWRENCE UNIVERSITY, Canton, N. Y., conferred at commencement an honorary degree on Dr. Leonard Carmichael, president of Tufts College, formerly professor of psychology at Brown University and at the University of Rochester.

DR. HENRY F. JOHNSTONE, professor of chemical engineering at the University of Illinois, was presented at the thirty-fifth semi-annual meeting on May 10 with the award of the American Institute of Chemical Engineers. The medal is awarded annually for "an outstanding contribution to chemical engineering literature within a three-year period." It was presented by James G. Vail, chairman of the award committee. The citation described as of "exceptional merit" papers read by Professor Johnstone on heat transfer and distillation before recent meetings of the institute.

DR. CHARLES F. WILINSKY, executive director and superintendent of the Beth Israel Hospital, Boston, chief medical officer of the Boston Public Safety Committee, was presented on April 12 with the annual medal of the Boston City Club for distinguished civic service, in recognition of "the outcome of his work in organizing the medical section of the city's civilian defense effort, and for his work during the Cocoanut Grove disaster." This gold medal is presented each year to the citizen adjudged by the club to have "rendered the most outstanding civic service to greater Boston."

THE Clarke Memorial Medal for 1942 has been awarded by the council of the Royal Society of New South Wales to Dr. W. L. Waterhouse, of the University of Sydney, for "outstanding contributions in the sphere of natural science, particularly in plant pathology."

THE fellowship award of $1,000 of Sigma Delta Epsilon has been made to Dorothy Marie Ziegler to further her work at the Barnard Free Skin and Cancer Hospital, St. Louis, on changes in epidermal cells, comparing harmless and malignant cells through the application of improved new techniques. The work is being carried on under the direction of Dr. Edmund V. Cowdry, of Washington University.

THE American Association of University Women has made twelve grants to conduct research projects under $1,500 fellowship awards for 1943–44. Among those receiving awards in the sciences are Harriett F. Mylander, of Baltimore and Cambridge, to complete a scientific study of central inhibition; Elly M. Jacobsen, of the University of California at Los Angeles, research in the physiology of reproduction; Dr. Elizabeth Z. Burkhart, of Clarksville, Ark., experiments in endocrinology, and Dr. Dorothy I. Parker, botanist of Bargersville, Ind., to write the second volume of a botanical encyclopedia of the United States.

IT is reported in *Nature* that at the annual meeting of the British Institution of Chemical Engineers, on April 2, the following medals for 1942 were presented: *Osborne Reynolds Medal,* L. O. Newton; *Moulton Medal,* W. K. Hutchison and Dr. E. Spivey, for their paper on "Design and Performance of Cooling Towers"; *Junior Moulton Medal and Award,* Dr. S. H. Wade, for his paper on "Evaporation of Liquids in Currents of Air"; *William Macnab Medals,* J. H. Sharp and F. J. Wilkins.

DR. E. W. SMITH has been elected president of the British Institute of Fuel for the session 1943–44. He will take office in October.

PRESTON S. MILLAR, president of the Electrical Testing Laboratories, has been elected president of the New York Electrical Society. Dr. Colin G. Fink, professor of electrochemistry at Columbia University, has been elected first vice-president.

H. E. ROBINSON, assistant chief chemist of Swift and Company, Chicago, has been made president of the Chicago Chemists Club.

PROFESSOR H. H. KNIGHT, of the department of zoology of the Iowa State College, was elected on May 6 president of the college chapter of Sigma Xi.

DR. DAVID W. E. BAIRD, JR., acting dean, has been appointed dean of the Medical School at Portland of the University of Oregon. He succeeds Dr. Richard B. Dillehunt, who has resigned.

DR. GEORGE D. SCARSETH, who has been serving as professor of soils and as soil chemist at the Experiment Station of Purdue University, has been appointed head of the department of agronomy, effective on July 1. He has been a member of the department since 1937 and succeeds Professor A. T. Wiancko, who is retiring on June 30 after serving for forty years. Eric W. Stark, of the Texas State Forest Service, has been appointed associate professor of forestry in the School of Agriculture and associate in forestry and conservation in the Experiment Station. For the past three years, he has served as chief of the Division of Forest Products Research. He will carry on research and teaching in wood properties and wood utilization.

P. I. DEE has been appointed professor of natural philosophy at the University of Glasgow.

DR. MAURICE L. TAINTER, professor of pharmacology at Stanford University and at the College of Physicians and Surgeons, San Francisco, has been named research director of the Winthrop Chemical Company. His headquarters will be at Rensselaer, N. Y.

DR. T. SMITH TAYLOR, formerly professor of physics, in charge of the Graduate School of the Newark College of Engineering, has become chief of selenium rectifier development with the Federal Telephone and Radio Corporation at East Newark.

PROFESSOR HARVEY BRACE LEMON is on leave of absence from the University of Chicago. He has become chief physicist at the Ballistics Research Laboratory, Aberdeen Proving Grounds, for the duration of the war.

DR. MARGARET D. CRAIGHILL, dean of the Woman's Medical College of Pennsylvania, has leave of absence to enable her to accept a commission of major in the division of preventive medicine in the Surgeon General's Office. She will specialize in preventive medicine in the Women's Army Auxiliary Corps.

DR. E. RAYMOND HALL, Guggenheim fellow, University of California at Berkeley, returned on May 2 after two and a half months spent in Mexico, where he made ethno-zoological studies in the field. While in Mexico he gave illustrated lectures at the Instituto de Salubridad y Enfermedades Tropicales and at the Benjamin Franklin Library on the results of his biological studies in Michoacan and on the Latin American fellowships offered by the University of California.

SIR HAROLD HARTLEY has been appointed general treasurer of the British Association as from April 1, the beginning of a new financial year. He succeeds Professor P. G. H. Boswell, who has resigned after twelve years' service in office, first as a general secretary (1931–35), and then as general treasurer (1935–43).

IT is reported in the *Times*, London, that the British Ministry of Agriculture, the Department of Agriculture for Scotland and the British Ministry of Information have asked a party of four agriculturists with practical experience of the food production campaign to visit the United States and Canada in the near future. The party will consist of T. R. Ferris, executive officer of the Dorset War Agricultural Executive Committee; Watson Jones, vice-chairman of the Shropshire War Agricultural Executive Committee; T. B. Manson, Divisional Land Officer of the Department of Agriculture for Scotland; and A. G. Street, farmer and author. They will tour the United States and Canada, giving lectures on the British farmers' war effort. The visit is expected to last for two to three months.

RICHARD P. STRONG, Colonel, M.C., A.U.S., director of tropical medicine at the Army Medical School, Washington, D. C., delivered the Leo Loeb Lecture at Washington University Medical School, St. Louis, on April 29. The problems of the war regarding malaria, bacillary dysentery, filariasis and typhus fever were especially discussed. On April 30 at the School of Medicine of St. Louis University he delivered an address upon plague.

DR. ERNEST CARROLL FAUST, professor of parasitology and head of the department of tropical medicine of the School of Medicine of Tulane University, delivered the third series of Ernest A. Sommer Memorial Lectures at the Medical School of the University of Oregon, Portland, from May 17 to 22. The first lecture was entitled "Horizons of American Tropical Medicine"; other lectures were on "Insects as Agents and Transmitters of Disease," "Malaria," "Yellow Fever and Dengue," "Amebiasis" and "Filariasis."

DR. CARL J. WIGGERS, professor and director of physiology at the Western Reserve University Medical School, has recently given the following lectures: "The Irreversibility Characteristic of Shock," before the Detroit Physiological Society on March 18; "The Value of Adrenal Cortex Preparations in Hemorrhagic Shock," Michigan Academy of Science Shock Symposium on March 26, and "Experimental Approaches to the Shock Problem," Adam Miller Lecture at the Long Island Medical College, Brooklyn, N. Y., on April 13.

PROFESSOR J. EDWARD HOFFMEISTER, of the department of geology of the University of Rochester, gave a public lecture on April 22 on "The Importance of Geology in Military Strategy in the Pacific Campaign." This was the second in a series of popular scientific lectures sponsored by the university chapter of the Society of the Sigma Xi. These lectures were initiated to acquaint the public with modern scientific facts of present-day importance. The first lecture of this series was given by Professor J. R. Murlin, of the university, on January 22. He spoke on "Food Rationing and the Nutritional Welfare of Our People."

PROFESSOR CARL O. DUNBAR, director of the Peabody Museum, Yale University, gave the address following the annual dinner of the Sigma Xi Club of the University of Connecticut on April 22.

A SERIES of six lectures is being given under the auspices of the New York Institute of Finance on Mondays, at 3:45 o'clock, in the Governors' Room of the New York Stock Exchange. The lecturers include John Mills and Dr. K. K. Darrow, of the Bell Telephone Laboratories, and Dr. Willard F. Libby, of the University of California.

IN the issue of SCIENCE for April 23, Dr. Foster Kennedy was referred to as professor of neurology at the College of Physicians and Surgeons of Columbia

University. Dr. Kennedy is professor of neurology in the Cornell University Medical College.

A MEETING of the American Physical Society, including invited and contributed papers, will be held at Stanford University, Calif., on July 10.

DR. T. R. HOLLCROFT, associate secretary of the American Mathematical Society, reports that the three hundred ninety-fifth meeting of the society was held at Hunter College, New York City, on April 24. The attendance was about two hundred, including one hundred and forty-three members. The following addresses were given by invitation of the program committee—"Spectral Theory," by Professor Nelson Dunford, of Yale University, and "Absolutely Convergent Trigonometric Sums," by Professor R. H. Cameron, of the Massachusetts Institute of Technology. There were two sessions at which thirteen contributed papers were presented. Ten additional papers were read by title. The excellent arrangements made by the department of mathematics of Hunter College were very much appreciated by all attending the meeting.

PROFESSOR H. J. VAN CLEAVE writes: "The general seminar in the department of zoology and physiology of the University of Illinois has devoted two meetings per month through the current year to the history of zoology in some of the leading American universities. In most instances a full hour has been given to each of the more important institutions with a former student or staff member from that institution in charge of the program. In the aggregate these programs have given a fairly comprehensive sketch of biology in America."

A GIFT of $43,500 from the Rockefeller Foundation has been made to Columbia University in support of three years' research on problems of intermediate metabolism in the department of biochemistry.

THE Paleontological Research Institution of Ithaca, N. Y., has recently been presented by Mrs. C. S. Bentley, of Plattsburg, N. Y., with a collection of recent sea shells mainly obtained from the West Coast though with genotype representatives from other oceanic regions.

DR. C. C. LITTLE, director of the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Maine, has announced a grant of $35,000 to the laboratory from the trustees of the Rockefeller Foundation. This grant is for a five-year period beginning on July 1, and is a contribution toward the expenses of establishing and maintaining a mammalian stock center. According to Dr. Little the money will be used primarily in connection with the work at the Hamilton Station in Salsbury Cove. It is hoped that in the five-year period a good beginning may be made in the establishment and maintenance of stocks of rabbits, rats and guinea pigs for use in scientific experimentation. Work has already been under way for some time at the Hamilton Station. It is hoped that the scientific results obtained will be of value not only in cancer research but to experimental medicine as a whole.

DISCUSSION

"MOCK DOMINANCE"

IN a recent issue of SCIENCE,[1] Richey points out that a hybrid from two plants, one with twice as many internodes of half the length of the other, would have a greater height than either parent, providing the hybrid internode number and length were each the arithmetical mean of those of the parents. For such gene interaction resulting in heterosis in height he suggests the term "mock dominance" which he considers not to be dominance in its genetic sense. I believe further comment is necessary to clarify the issue.

(1) If height can be taken as a statistical creation compounded of two fundamental elements (internode length and number), then Richey's conclusions and terminology are justifiable. One might as logically, however, consider height and internode length as fundamental and their quotient, internode frequency, a compound. It should be noted in this connection that, in an actual cross, the factors would not necessarily interact in the manner postulated by Richey.

(2) If a particular gene substitution always makes the same contribution to the total effect, gene interaction is said to be absent. If the contribution is not always the same but depends merely on the total effect of the residual genes, the scale may be transformed into one on which each factor has the same effect throughout the range.[2] Interaction that can be thus eliminated by the use of a transformed scale may conveniently be termed "statistical interaction."

In other cases the effect of a gene substitution depends not merely on the total effect of the residual genes but also on the particular genes producing this total effect. That this is the case in the example proposed by Richey will be apparent from a consideration of the following list of genotypes and the relative

[1] F. D. Richey, SCIENCE, 96: 2490, 1942.

[2] See, for example, S. Wright, *Jour. Amer. Statist. Assoc.*, p. 163, 1926.

plant heights resulting from the gene action which he postulates:

nndd	1
nnDd, Nndd	1.5
NNdd, nnDD	2
NnDd	2.25

The substitution of N for n in a genotype which would otherwise produce a plant 1.5 units in height gives a genotype producing a plant either 2 or 2.25 units in height, depending on the residual genes present. Interaction of this type can not be made to disappear by transformation of scale and is non-"statistical" in the sense defined above. In this particular example it can be thought of either as complementary (inter allelic) or dominance (intra allelic) interaction. Only non-statistical interaction can ever lead to heterosis in the offspring of two equal parents with respect to the measure considered.

It is doubtful whether non-statistical interaction should be described as "mock" regardless of the measure involved even though the existence of gene interaction based on certain measures might be relatively insignificant from the standpoint of analysis of gene action or of practical application.

(3) If the action of any particular gene substitution affecting internode number or length were proportional to the total effect of all the genes present, the height of the hybrid in Richey's example would equal that of the two parents. In such case the logarithms of height, internode number and internode length would all constitute scales on the basis of which interaction is absent. Probably no other type of simply expressed gene action can result in the absence of non-statistical interaction for measurements related to each other as products, quotients and powers, as are lengths, areas, volumes and many shape indices. This constitutes a statistical reason for expecting more frequently an approximation toward independent action of gene differences when the action is expressed as logarithms of measures of these types than when expressed as the measure themselves or any other simple function of them.

EVERETT R. DEMPSTER

DIVISION OF GENETICS,
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A NEW GROWTH FACTOR FOR STREPTOCOCCUS LACTIS

USING as standard a sample of folic acid concentrate (7.7 per cent.) kindly supplied by Dr. R. J. Williams we compared the amount of folic acid[1] and norite eluate factor[2] in various types of extracts and liver preparations and found that some of these materials are much more active for *Streptococcus lactis R* than for *Lactobacillus casei*. In contrast an extract of spinach had the same degree of activity for both organisms.

These differences can be demonstrated to be due to the presence of another substance which we have now isolated. The new substance effectively replaces the folic acid standard in the case of *S. lactis* but is inactive for *L. casei*. We have calculated that 1γ of this product has the same potency for *S. lactis* as 56γ of the folic acid standard but that the same amount of this factor is less active than 0.0004γ of the folic acid standard for *L. casei*.

We believe that this newly isolated substance, for which we have reserved the designation of a name until its chemical nature is determined, is not folic acid or the norite eluate factor but a new growth factor.

JOHN C. KERESZTESY
EDWARD L. RICKES
JACOB L. STOKES

RESEARCH LABORATORIES,
MERCK AND COMPANY, INC.,
RAHWAY, N. J.

[1] Folic acid was determined by means of the *Streptococcus lactis R* assay method of Mitchell, Snell and Williams. (*Jour. Am. Chem. Soc.*, 63: 2284, 1941.)

[2] Norite eluate factor assays using *Lactobacillus casei* (B. L. Hutchings, N. Bohonos and W. H. Peterson, *Jour. Biol. Chem.*, 141: 521, 1941) were made in essentially the same medium as for folic acid assays.

SULFAGUANIDINE OR SULFA-AMIDINE?

INCONSISTENCIES or inaccuracies in nomenclature are fairly common in the field of chemistry. The offense to students is perhaps not serious when such practice involves unusual cases. This does not, however, justify an attitude of indifference in the matter of accuracy whether it be in naming compounds or in the use of scientific terminology. Attention is called here to the misnaming of one of the sulfa drugs. The names and formulas of the more common and useful of these compounds are to be found in most recent editions of books on chemotherapy or biochemistry. An acquaintance with the parent compound and the modifying groups would enable any one to write the formulas of such compounds as sulfathiazole, sulfapyridine or sulfadiazine. To apply the same technique in the writing of the formula for sulfaguanidine would lead to obvious error. In the interests of accuracy this substance should be named sulfa-amidine or, for those who desire a more euphonious name, sulfamidine.

C. A. HOPPERT

DEPARTMENT OF CHEMISTRY,
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CLASS DISTINCTION AMONG AMERICAN MEN OF SCIENCE

IN several preceding editions of the Biographical Directory of American Men of Science, one thousand

were differentiated from the rest by means of a star attached to their names and designated the "leading men of science." It is now proposed to continue this class distinction in a new edition of the directory.

I do not know of any useful purpose that has been served by the formation of a superior class of scientists, but I do know that it has created no end of ill feeling among those who have been excluded. Moreover, if it is useful to "star" one thousand and designate them the "leading men of science," why would it not be useful to "double star" five hundred of these as super leaders and "triple star" one hundred as super, super leaders, etc.?

It seems to me that in a democracy class distinction should everywhere be discouraged as much as possible and that there should be no fixed differentiation into classes in any group of individuals without the sanction of the group. I therefore suggest that the continuation of "starring" of scientists in the directory be put to a vote of those involved.

S. O. MAST

JOHNS HOPKINS UNIVERSITY

SCIENTIFIC BOOKS

LIGHT

Chemical Aspects of Light. By E. J. BOWEN. 191 pages. New York: Oxford University Press. January, 1943. $4.00.

THIS little book covers a wide range of subject-matter and is "intended only for the student who, whether by youth, age or other cause, is not equipped to participate freely in the mathematical struggles by which formal and quantitative solutions of problems are obtained." It is addressed therefore to those who, not equipped to make new advances themselves, "wish to know something of a branch of contemporary science." Even with mathematics at a minimum, both youth and age will find the book hard reading in places, probably by reason of the great compression of material in the text. The first chapter on waves and matter, 32 pages long, has paragraphs on linearly, circularly and elliptically polarized waves, the electromagnetic theory of Maxwell, the electronic theory of matter, interference, diffraction, resolving power of optical instruments, the electron microscope, lenses, double refraction or birefringence, fluorescence, optical activity, strains in materials, liquid crystals, streaming double refraction in colloidal systems, Tyndall light scattering, depolarization, reflection, absorption and transmission, dispersion and refraction, the photoelectric effect, Rayleigh scattering, glossy and matt surfaces, color of pigments and nephelometry. It makes a concentrated diet for any reader.

Ten chapters follow the first and expand some of the topics. Chapter 3, with 47 pages on the absorption and emission of light, is a good summary of atomic and molecular spectra. Succeeding chapters treat fluorescence, luminescence of solids, photochemical reactions, photosynthesis (perhaps the evidence from radioactive carbon should have been included in this), the photographic process (a brief, compact survey of the essentials in 8 pages), the reactions of the retina, photo-cells and chemiluminescence. There are 17 pages of appendices on light filters, photochemical technique and phosphors. There are three pages of bibliography and a Table of Constants. In this latter the value for the velocity of light in vacuo $= 2.99796 \times 10^{10}$ cm per sec, should be, according to Birge, 2.99776. If youth and age find the book difficult reading the trained chemist, not specialist in this field, can find here a trustworthy summary of the present state of the science. The format, printing, paper and binding of the book are a tribute to the Clarendon Press in the third year of total war.

HUGH S. TAYLOR

EMBRYOLOGY

The Embryological Treatises of Hieronymus Fabricius of Aquadependente. The Formation of the Egg and of the Chick (De Formatione Ovi et Pulli). The Formed Fetus (De Formato Foetu). A facsimile edition, with an introduction, a translation and a commentary. By HOWARD B. ADELMANN. Ithaca, N. Y.: Cornell University Press. xxiv + 883 pp. 46 plates. 1942. $12.50.

JEROME FABRIZIO, born at Aquadependente, was professor of anatomy at Padua from 1565 to 1613. In this chair he was the third of the distinguished successors of Andreas Vesalius. His importance as a teacher is sufficiently attested by the fact that his greatest pupil, William Harvey, not only obtained one of the most important clues for his discovery of the circulation of the blood from Fabricius's description of the valves of the veins, but also founded his lifelong studies of embryology upon those of his master.

Fabricius himself was the first since the time of Aristotle to study embryology from a comparative point of view. Through his lectures and his two books on animal development he raised embryology to the rank of an independent science. The first of these books, that on the formed fetus, appeared in 1604; the second, which deals with the embryology of the chick, was published after his death, in 1621. In spite of their importance, neither was ever translated into any modern language, and it is now more than

two hundred years since they were last published in Latin. Through the devoted labor of Professor Adelmann these books, the foundation stones of modern embryology, are now set before us in a noble volume which contains the two Latin texts in facsimile, with English translations which are both readable and scholarly, entertaining biographical notes and instructive commentaries, copious annotations and cross-references and a detailed bibliography.

The studies of Fabricius were of course made without the microscope. They concern the structure of the reproductive organs of the hen, the structure of the egg and the way in which the embryo is laid down. The observations on the mammalian fetus concern almost exclusively the placenta, membranes and fetal blood vessels. As Professor Adelmann points out, the ultimate goal of Fabricius, as of Aristotle and Galen, was "to explain causes, and particularly to elucidate the final cause, the end or purpose served by each part." Structure and function were studied primarily for their aid in the comprehension of the end or useful purpose. These two books therefore are couched in a tone of scholastic inquiry which requires (and receives) a good deal of explanation by the translator in order to make them clear to the present-day reader. In his introductory chapters, Adelmann traces the previous history of embryology from Aristotle through Galen and the sixteenth century writers, including Vesalius and Coiter. Then, in a careful analysis of the text of Fabricius, he shows us how the latter began his work saturated with the spirit and point of view of Aristotle and Galen and how he had to adjust his observations of fact to the doctrinal patterns of his times.

There has been a tendency to over-emphasize the traditionalism and the factual errors of Fabricius. He made several striking mistakes, such as deriving the chick from the chalazae of the egg; but these are completely outweighed by a host of careful and (for the time) accurate descriptions of the egg and the chick, of the mammalian placenta and membranes and of the umbilical and fetal vessels. He studied a very wide range of species, and was the first to describe and illustrate in print the diffuse placenta of the pig and horse and the human decidua. The illustrations which accompany his texts are remarkably clear and instructive, and many of them could still be used for teaching. They are well reproduced in this volume.

The reviewer has perhaps said enough to indicate that Dr. Adelmann has provided much more than reprints and translations of these books. He has shown us their proper place in the history of embryology and has made it possible for students in our day to understand the achievement of their author.

Students of Harvey will find here a careful study of the relations between his work and that of Fabricius. In the translations, all the more important passages which Harvey quoted from Fabricius are specially indicated.

This work, from its touching Latin dedication to the memory of Dr. Adelmann's mother and sister, through to its excellent index, is a monument of scholarship—learned, thorough and withal interesting, and satisfyingly complete. Students of embryology and of the history of science, now and in the future, will be grateful not only to the author, but also to Cornell University, the Council of Learned Societies and the Carnegie Corporation, for making its publication possible. Special mention should be made of the handsome format, and of the typography designed by Robert Josephy, which combines beauty and legibility with a clever suggestion of seventeenth century style, making the English translations and the commentaries appear fully compatible with the dignified Paduan printing of the Latin texts.

GEORGE W. CORNER

SPECIAL ARTICLES

CURARE ALKALOIDS FROM CHONDODENDRON TOMENTOSUM

CURARE is the generic name for a group of highly effective arrow poisons of plant origin used by the South American Indians. Recent clinical work has given encouraging indications that this drug, with its powerful lissive action on the voluntary musculature, might become a valuable therapeutic agent in the treatment of spastic paralysis, for moderating the convulsions in the shock-therapy of certain psychoses, and as an adjunct to anesthesia in surgery. So far, the chief obstacle to the therapeutic use of curare has been the widely varying potency and the uncertain origin and composition of the available preparations.

The isolation of a physiologically active, crystalline alkaloid from curare proved to be a difficult task. After numerous unsuccessful attempts by other workers, H. King, in 1935, finally announced the isolation of a crystalline, highly active quaternary base chloride, designated by him d-tubocurarine chloride, from a specimen of tube curare.[1] The earlier work of M. Scholtz, of E. Spaeth and of F. Faltis on the inactive tertiary base, l-curine from curare, and the related alkaloids bebeerine and isobebeerine (isochondodendrine) found in the drug *pareira brava,* enabled King to establish the structure of d-tubocurarine chloride as that of a bisbenzylisoquinoline alkaloid in which the nitrogen atoms are quaternary (formula I). On the

[1] H. King, *Jour. Chem. Soc.* (London) 1381, 1935.

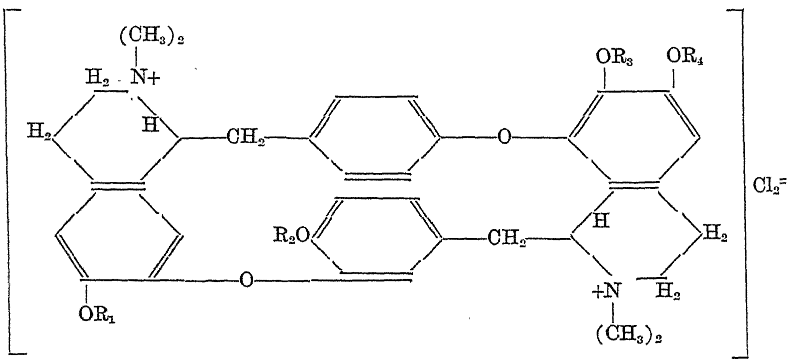
basis of a subsequent chemical investigation of pot curare[2] and of the tertiary alkaloids from various menispermaceous plants[3] this author expressed the belief that the still unsettled problem of the botanical provenance of tube- and pot-curare would eventually be solved by an examination of the N. O. Menispermaceae and particularly of the genus *Chondodendron.*

The problem of identifying the botanical species employed by the Indians of the Amazon region in the preparation of curare has been admirably clarified by the work of Krukoff and Moldenke.[4] Their definitive study of the American Menispermaceae leaves little to be desired in the way of botanically correlating the various species used as ingredients. They list as important in this respect: *Abuta imene, Chondodendron polyanthum, Ch. limaciifolium, Ch. tomentosum, Ch. ignitanum, Ch. candicans, Telitoxicum minutiflorum, T. peruvianum* and *Abuta rufescens,* all menisperms, and also several *Strychnos* species.

Chondodendron tomentosum to that of native Peruvian curare, cite this fact as supporting evidence for the statement of Krukoff that this plant is the chief ingredient. Folkers was also careful to point out that the Indians extract green fresh bark, whereas the laboratory tests were made with dried bark, and that this may account for the essentially negative results.

On the other hand, the essential ingredients of calabash curare are almost certainly not menispermaceous plants, but members of the *Strychnos* family. This follows from the work of Wieland and collaborators,[7] who isolated from calabash curare several highly active quaternary bases chemically unrelated to the bisbenzylisoquinoline alkaloids, and later demonstrated the presence of some of these compounds in the bark of *Strychnos toxifera.*

We have had the opportunity to examine a sample of curare, prepared by Indians of the upper Amazon, in which only one plant species, namely *Chondodendron tomentosum,* was used. The plant species was identified by a botanist at the time of preparation and authenticated by herbarium specimens. We have been able to isolate from this curare, by procedures which will be described in detail elsewhere, four crystalline tertiary bases and a highly active crystalline quaternary base, which was shown to be identical with the d-tubocurarine of King. In terms of physiological activity the yield of the quaternary alkaloid was 40 per cent.



I. *d-Tubocurarine chloride*
$R_1 = CH_3$; $R_2 = H$; of R_3 and R_4, one is H, the other CH_3.
II. *d-Chondocurine dimethochloride*
$R_1 = CH_3$; $R_2 = H$; of R_3 and R_4, one is H, the other CH_3, but in arrangement which is the reverse of that in I.
III. *d-Tubocurarine dimethylether iodide*
$R_1 = R_2 = R_3 = R_4 = CH_3$; anion $I^=_2$ instead of $Cl^=_2$.

The authenticated plant material collected by Krukoff was investigated chemically and pharmacologically by Folkers.[5] Later, Folkers and Unna[6] reported on the chemical examination of Chazuta curare and its botanical components. As with other species, the crude extract obtained from the dried stem bark of *Chondodendron tomentosum* proved to be highly toxic to frogs and failed to elicit the typical curare response. After separation of the alkaloids into quaternary and non-quaternary fractions, the former caused the characteristic curare symptoms in frogs but was toxic to a cat. The authors, commenting on the close resemblance of the action of this fraction from

The tertiary bases, three of which (1, 3 and 4 below) represent isomers of the formula $C_{36}H_{38}O_6N_2$, are:

(1) d-Isochondodendrine, a phenolic alkaloid previously obtained by Scholtz[8] from *pareira brava* and by King[3] from various other *Chondodendron* species.

[2] H. King, *Jour. Chem. Soc.* (London) 1472, 1937.
[3] H. King, *Jour. Chem. Soc.* (London) 737, 1940.
[4] B. A. Krukoff and H. N. Moldenke, *Brittonia,* 3: 1, 1938.
[5] K. Folkers, *Jour. Am. Pharm. Assoc.,* 27: 689, 1938.
[6] K. Folkers and K. Unna, *Arch. Int. Pharmacodyn.,* 61: 370, 1939.
[7] H. Wieland *et al., Ann.* 627: 160, 1937; 536: 68, 1938; 547: 140, 156, 1940.
[8] M. Scholtz, *Arch. Pharm.,* 251: 136, 1913.

(2) d-Isochondodendrine dimethylether, an alkaloid encountered so far only in an asiatic Menisperm, *Cissampelos insularis*.[9] (3) A new alkaloid for which we propose the name *d-chondocurine*. By N-methylation this compound was converted into amorphous quaternary halides (chloride and iodide) which differed chemically and in physiological activity from the corresponding halides of d-tubocurarine. However, on methylation of the phenolic groups in addition to N-methylation it yielded a crystalline dimethylether dimethiodide which was found to be identical with d-tubocurarine dimethylether iodide (III). It must therefore be concluded that d-chondocurine corresponds to d-tubocurarine in regard to the basic ring skeleton and the configuration of the asymmetric centers, but differs from it besides in the valency of the nitrogen atoms, by the arrangement of methylated and free phenolic hydroxyl groups (II). It is noteworthy that the as yet unknown tertiary base, ("d-tubocurine"), corresponding in *all* respects to d-tubocurarine has so far not been encountered by us in *Chondodendron tomentosum* in spite of the relative abundance of the quaternary base in this plant. (4) A new levorotatory alkaloid, differing from l-curine, the tertiary base previously found in curare by Boehm[10] and isolated by King and others from extracts of various *Chondodendron* species. The new alkaloid yielded a crystalline dimethiodide and an amorphous dimethylether dimethiodide. Pending the preparation of larger amounts the question of its chemical relationship to the other alkaloids of this group will have to be left open. There was no evidence for the presence of either l-curine or its enantiomorph, d-bebeerine, in our extract.

In Table 1, the properties of the isolated alkaloids as well as of the quaternary bases and the quaternary dimethylethers prepared from them are recorded. The potency of d-tubocurarine chloride measured by the rabbit head drop method of Holaday,[11] is 6.5 units per mg.[12] The same value is obtained for the (amorphous) iodide of this base after correction for the different atomic weight of the anion. The finding that the quaternary derivative of d-isochondodendrine is practically devoid of lissive action is confirmatory of earlier reports.[13] The more surprising is the fact that the quaternary base derived from d-chondocurine (either in the form of the chloride or the iodide) possesses about three times the lissive potency of d-tubocurarine. Also the crystalline quaternary base corresponding to alkaloid 4 is only slightly less potent than d-tubocurarine. This is, to our knowledge, the first instance where tertiary alkaloids of the bisbenzylisoquinoline type have been shown to yield quaternary bases approximating or exceeding in physiological potency the active constituents of native curare.

TABLE 1

ISOLATED AND DERIVED ALKALOIDS FROM CHONDODENDRON TOMENTOSUM

Tertiary alkaloids	Quaternary alkaloids
d-Isochondodendrine* m.p. 300°; $[\alpha]_D + 120°$ (0.1N HCl)	d-Isochondodendrine dimethiodide m.p. 280°; $[\alpha]_D + 87°$ (water). < 0.4 units per mg.
d-Isochondodendrine dimethylether* m.p. 270°; $[\alpha]_D - 15°$ (chloroform)	d-Isochondodendrine dimethylether dimethiodide m.p. 300°; $[\alpha]_D - 7°$ (ethanol). 1.6 units per mg.
d-Chondocurine* m.p. 234°; $[\alpha]_D + 200°$ (0.1N HCl)	d-Chondocurine dimethiodide ("d-Chondocurarine iodide") amorphous; $[\alpha]_D + 178°$ (methanol). 20 units per mg. dimethylether identical with d-tubocurarine dimethylether iodide.
Alkaloid 4* m.p. 167°; $[\alpha]_D - 248°$ (0.1N HCl)	Dimethiodide of Alkaloid 4 m.p. 250°; $[\alpha]_D - 135°$ (methanol). 5 units per mg. Dimethylether dimethiodide of Alkaloid 4 amorphous 18 units per mg.
Tertiary alkaloid corresponding to d-tubocurarine ("d-tubocurine") unknown.	d-Tubocurarine chloride* m.p. 275°; $[\alpha]_D + 225°$ (water). 6.5 units per mg. d-Tubocurarine dimethylether iodide m.p. 266°; $[\alpha]_D + 160°$ (water). 60 units per mg.

* Alkaloids isolated from *Chondodendron tomentosum*; the other compounds are derivatives prepared in the laboratory. The standard errors for the potency figures given lie within a range of ± 2 to 3 per cent.

The unexpected finding that methylation of the free phenolic hydroxyl groups in all the quaternary bases markedly increased the physiological activity is likewise of interest. In the case of d-tubocurarine, this increase is about nine-fold, and with d-chondocurine dimethiodide, which yields the same dimethylether, three-fold. A similar enhancement of potency (about four-fold) results from the O-methylation of the dimethiodide of alkaloid 4 and, on a considerably lower level of activity, of d-isochondodendrine dimethiodide. O-ethylation of d-tubocurarine has no such marked effect (diethylether iodide, 10 units per mg), while

[9] H. Kondo, M. Tomita and S. Uyeo, *Ber. Dtsch. Chem. Ges.*, 70: 1890, 1937.

[10] R. Boehm, *Abh. Kgl. sächs. Ges. Wiss.*, 22: 203, 1895; 24: 23, 1896; *Arch. Pharm.*, 235: 660, 1897.

[11] H. Holaday, to be published.

[12] The unit referred to its equivalent to 1 mg of an arbitrary curare standard preparation, which was later shown by us to contain likewise d-tubocurarine as the active principle. The potency figures for the other compounds listed in Table 1 were arrived at by comparison with this standard or with crystalline d-tubocurarine chloride. We wish to emphasize that the relative potencies thus determined hold true only when the rabbit is employed as the test animal. When d-tubocurarine dimethylether iodide was compared with the unmethylated base by the same technique in other species (monkey, mouse, dog) the ratios deviated considerably from that obtained in the rabbit. These findings as well as the data incorporated in this paper will be reported in detail by Holaday and associates in a separate communication. We wish to express our sincerest thanks to Mr. H. Holaday of the Biological Laboratories of E. R. Squibb and Sons for placing the bioassay data at our disposal.

[13] M. Scholtz, *Arch. Pharm.*, 252: 513, 1914.

O-butylation renders the quaternary base practically inactive.

In conclusion, we wish to point out that the availability of pure crystalline preparations with high curare activity will fill an urgent need for well-defined material for physiological and clinical experimentation.

SUMMARY

Crystalline d-tubocurarine has been isolated in good yield from curare prepared from a single plant species, namely, *Chondodendron tomentosum*. This result establishes with certainty the botanical origin of this compound and substantiates the supposition that it is this species which furnishes the active constituent in certain types of curare.

The extract from this plant furthermore yielded two new tertiary alkaloids which could be converted into physiologically active quaternary bases.

Methylation of the phenolic hydroxyl groups in the quaternary bases resulted in a 3–9-fold increase in physiological potency.

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THE IN VITRO EFFECT OF INSULIN IN PIGEON BREAST MUSCLE[1,2]

IN 1938 Krebs and Eggleston[3] demonstrated an *in vitro* oxidative effect of insulin on a suspension of minced pigeon breast muscle in phosphate buffer to which has been added certain oxidizable substances. The effect was especially pronounced in the presence of citric acid. While these observations have been confirmed by other investigators,[4,5,6] the site of action of insulin in this experimental system is unknown, although Krebs and Eggleston concluded that their evidence "suggests that insulin acts as a catalyst in the citric acid cycle."

It seemed possible to us that information in regard to the action of insulin in this experimental system could be obtained by studying the respiration of a suspension of minced pigeon breast muscle during the period when the insulin effect is present.

TABLE I

THE EFFECT OF INSULIN ON AEROBIC PYRUVATE REMOVAL

Two flasks contained 2.5 gm of minced pigeon breast muscle in 22.5 ml of calcium-free phosphate saline (pH 7.4) + 5.0 ml boiled muscle extract. One flask (enzyme A) received 1.5 ml phosphate buffer; the other (enzyme B), 1.5 mgm zinc-free insulin in 1.5 ml phosphate buffer. Both vessels were gassed with 100 per cent. O_2. 4.0 ml samples from each flask were placed in Warburg vessels, gassed with 100 per cent. O_2 and shaken at 40° C. until these pilot vessels showed the beginning of the insulin effect (ca. 80 minutes). The reserve flasks which had been shaken at 40° during this time were removed from the water bath and 4 ml of the enzyme suspensions + other additions were added to Warburg vessels as indicated in the table. The vessels were gassed with 100 per cent. O_2, equilibrated at 40° C. for 10 minutes, and substrates tipped in from the side arm. 20 per cent. KOH was placed in the center cup. Total volume of liquid: 4.7 ml. Experimental period, 25 minutes. Pyruvic acid was measured by the carboxylase method.

Experiment:	1		2		3	
Vessel:	1	2	1	2	1	2
Enzyme A (ml.)	4.0	....	4.0	....	4.0	....
Enzyme B (ml.)*	....	4.0	....	4.0	....	4.0
Pyruvate added (µl.)	431	431	373	373	393	393
Pyruvate utilized (µl.)	91.5	234.0	69	191	224	300
O_2 uptake (µl.) .	390	475	441	475	634	944

* 1.1 units of insulin per ml.

In experiments to this end, we have found, first, that the greater oxygen uptake of a suspension of

TABLE II

EFFECT OF INSULIN ON THE O_2 UPTAKE AND PYRUVATE REMOVAL IN MALONATE-POISONED SYSTEMS

All manipulations are the same as those recorded in Table I. Malonate added to the vessel directly. The vessels were run for 70 minutes. The data in this table are from the same tissue suspension used in Experiment 2, Table I.

	Vessel									
	1	2	3	4	5	6	7	8	9	10
Enzyme A added (ml)	4.0	......	4.0	......	4.0	......	4.0	......	4.0	......
Enzyme B added (ml)*	......	4.0	......	4.0	......	4.0	......	4.0	......	4.0
Malonate conc. (M)	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Fumarate added (µl)	......	......	224	224	......	......	......	......	......	......
Oxaloacetate added (µl)	......	......	......	......	224	224	......	......	......	......
Citrate added (µl)	......	......	......	......	......	......	448	448	......	......
α-Ketoglutarate added (µl) .	......	......	......	......	......	......	......	......	448	448
Pyruvate added (µl)	373	373	373	373	373	373	......	......	......	......
Pyruvate recovered (µl)	275	246	235	167	360	311	......	......	......	......
Pyruvate utilized (µl)	98	127	138	206	†	†	......	......	......	......
O_2 uptake (µl)	159	194	272	452	222	282	183	192	164	154

* 1.1 units of insulin per ml.
† Calculation of pyruvate utilization in the presence of oxaloacetate is impossible since oxaloacetate yields 2 mols CO_2 in the carboxylase method and is also decarboxylated to an unknown degree when added to tissues. These data, however, indicate an increased pyruvate uptake in the presence of insulin and oxaloacetate.

1 This investigation was supported in part by a grant from Armour and Company.

2 The work reported here was done by Lester Rice in partial fulfilment of requirements for a Ph.D. in biochemistry, Division of Biological Sciences, University of Chicago.

3 H. A. Krebs and L. V. Eggleston, *Biochem. Jour.*, 32: 913, 1938.

4 E. Shorr and S. B. Barker, *Biochem. Jour.*, 33: 1798, 1939.

5 F. J. Stare and C. A. Baumann, *Cold Spring Harbor Symposia on Quantitative Biology*, 7: 1939.

6 W. C. Stadie, John A. Zapp, Jr., and F. D. W. Lukens, *Jour. Biol. Chem.*, 132: 411, 1940.

pigeon breast muscle to which insulin had been added (as compared to a control maintained under the same conditions for a similar period of time) is accompanied by an increased ability to utilize pyruvic acid (Table I).

We have found, further, that this pyruvate utilization can be inhibited by malonate and restored, as Krebs and Eggleston have demonstrated in the case of fresh suspensions of pigeon muscle,[7] by the addition of fumarate + pyruvate and of pyruvate + oxaloacetate. While both of these reactions occur at a greater rate in the insulin-supplemented tissue, the rates of citrate and α-ketoglutarate oxidation are unaffected by the presence of the hormone (Table II).

These data demonstrate for the first time a direct *in vitro* association between the action of insulin and the oxidation of a carbohydrate substrate, namely, pyruvic acid. They suggest further that insulin is concerned in maintaining the functional integrity of either one or both of the enzyme systems involved in the reactions of fumaric and pyruvic acid or of oxaloacetic and pyruvic acid.

These experiments will be reported in greater detail elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ISOLATION OF AN ACTIVE SUBSTANCE FROM CALONYCTION ACULEATUM CAPABLE OF COAGULATING CASTILLA LATEX

CASTILLA latex is different from Hevea latex in that it is not easily coagulated by common chemical reagents. For many years, a juice prepared by natives of Central America from the moonvine of Nacta vine (*Calonyction aculeatum* formerly *Ipomea bona-nox*) has been used to coagulate the latex tapped from the Castilla tree. The origin of this discovery is apparently unknown. With increased interest in Castilla rubber resulting from the present rubber emergency, it has been necessary to seek some method for coagulating Castilla latex on a commercial scale. Trafton[1] has devised a method by which the latex is creamed, washed and finally coagulated with chemicals, but the method requires that the pH of the latex be rather rigidly controlled during processing, a condition not always attainable under field conditions, particularly when native labor is used. The native method of coagulation with Nacta extract would continue to be reasonably satisfactory except for two problems: (1) The vine has been almost completely exterminated in its former habitats, where it was associated with Castilla trees, and (2) there are areas in which moonvine has never been found in association with Castilla. Hence, the desirability of isolating the active principle from Nacta vine has been suggested as offering a method whereby a dried extract or some other suitable concentrate might be prepared in one area to be shipped to some other area where Castilla latex is to be coagulated. As the following directions will indicate, this laboratory has been successful in isolating from Nacta a material which is very active in coagulating Castilla latex under laboratory conditions.

METHODS AND MATERIALS

Calonyction aculeatum grows abundantly in southern Florida. It has been possible, therefore, to have ample material shipped in from this source so as to arrive in optimum condition (material shipped from Mexico decayed in transit). Preliminary experiments indicated that no loss in activity was experienced when the vine was rapidly dried *in vacuo* at 70° C; similarly, it was found that the substance responsible for coagulating Castilla latex was not soluble in water, but was readily soluble in ethyl alcohol, acetone, ethyl ether, petroleum ether and benzene. With these facts in mind, the following procedure was adopted in preparing an active material.

Ten grams of dry stems of *C. aculeatum*, ground to pass 40 mesh, were extracted with ethyl ether for 12 hours in a Soxhlet apparatus. At the expiration of this period, the green ether extract was transferred to an evaporating dish and the ether removed, leaving a sticky mass of material heavily charged with chlorophyll. This was then dissolved in a small quantity of benzene, transferred to a beaker and activated charcoal added. The material was heated on a steam bath for about ten minutes to insure adequate adsorption. Filtration of the benzene extract to which charcoal had been added disclosed a yellow-colored filtrate from which most, if not all, of the photosynthetic pigments had been removed by adsorption on carbon. The filtrate was evaporated to dryness leaving a resinous mass of yellow color. This material was dissolved in a small quantity of acetone and then dispersed into approximately 30 ml of water, producing a white, cloudy, colloidal sol which, when viewed by reflected light, appeared to have a reddish tinge. The acetone was removed from the sol by warming on a steam

[7] H. A. Krebs and L. V. Eggleston, *Biochem. Jour.*, 34: 442, 1940.

[1] Unpublished data.

bath until the odor of acetone could no longer be detected. The hydrosol was cooled in an ice bath to about 5° C. Upon standing overnight in an ice chest, a yellow substance separated from the sol. When subsequently centrifuged at 4,500 RPM for 15 minutes, all the material was precipitated, leaving a clear supernatant liquid. The precipitated material was washed several times with water, the water decanted, the precipitate redissolved in acetone, filtered, redispersed into water, and the acetone removed as before. Centrifuging caused a clear, yellow, resin-like substance to collect at the bottom of the centrifuge tube. The resin was gathered on a stirring rod and removed from the tube for drying. From ten grams of dry plant material, 400 milligrams of dried resin were obtained, or a yield of about 4 per cent. on a dry weight basis.

Coagulation Tests of Calonyction Resin with Castilla Latex

The Castilla latex used in the following experiments was received from Mexico and labeled "Latex Castilla por de Pichucalco," and was collected on September 15, 1942. The shipment arrived in Washington on October 14, 1942, in apparently good condition. Ten milliliters of undiluted latex were measured in a graduate, poured into a 30 ml beaker and the desired amount of sol added for coagulative tests. The beakers were kept covered to diminish surface oxidation of the latex during the time of the test. When coagulation occurred, the rubber was separated from the serum at the end of 14 hours, washed several times in water, and weighed after being superficially dried in a low temperature oven. In some cases, the serum also was evaporated to dryness for rubber content determination. Resin and rubber analyses were made by the Bailey-Walker method using acetone and benzene as solvents for resins and rubber, respectively.

A sol containing 0.82 mg of resin per milliliter of water, and another sol containing 0.47 mg of resin per milliliter were prepared by first dissolving the resin in a small amount of acetone, dispersing the resin into water with stirring, removing all the acetone by warming, and then making the sol to a known volume with water. Tables I and II illustrate the coagulating powers of these sols, and the composition of the coagulum and serum.

TABLE I

Coagulative Power of a Calonyction Resin Sol Containing 0.47 mg of Resin Per Milliliter of Water. Ten Milliliters of Latex Used in All Tests

Ml of sol	Mg of nacta resin	Time of coagulation	Weight of rubber in grams
1.0	0.47	None in 12 hours	0
2.0	0.94	None in 12 hours	0
4.0	1.88	Begins in 30 minutes	2.35
8.0	3.75	Begins in 10 minutes	2.95
16.0	7.52	Begins almost at once	2.68

TABLE II

Coagulative Power of a Calonyction Resin Sol Containing 0.82 mg of Resin Per Milliliter of Water. Ten Milliliters of Latex Used in All Tests

Ml of sol	Mg of nacta resin	Time of coagulation	Per cent. rubber coagulated	Coagulum			Serum	
				Weight in grams	Per cent. resins	Per cent. rubber	Weight in grams	Per cent. rubber
0.5	0.41	None in 14 hours	0	0	...	....	10.32	...
1.0	0.82	None in 14 hours	0	0	...	....	10.32	...
2.0	1.64	10 minutes ±	20.7	2.14	5.60	72.34	8.18	5.63
4.0	3.28	5 minutes ±	23.3	2.41	6.37	58.27*	7.91	1.78
8.0	6.56	2 minutes ±	23.4	2.42	7.07	76.60	7.90	0.78

* Benzene extraction of rubber not complete after 32 hours.

These data are suggestive of the use that this resin may find in the commercial production of Castilla rubber. Since, however, absolutely fresh latex has been unavailable, we are hesitant in predicting the coagulative powers of Nacta resin under field conditions, and for this reason, we are withholding comment and interpretation of the data contained in the tables until the results of further trials on fresh latices have been ascertained.

S. G. Wildman
A. V. McMullan
Rosamond Griggs

Rubber Plant Investigations,
Bureau of Plant Industry,
U. S. Department of Agriculture

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SCIENCE NEWS

Science Service, Washington, D. C.

PARICUTIN, MEXICO'S NEW VOLCANO

I HAVE just seen Mexico's new volcano, Paricutin, from the air and it is like having a grandstand seat at the geologic drama that shaped the face of much of this country. Dr. L. C. Graton, of Harvard, and I flew to Uruapan from Mexico City in two small planes provided by Dr. Gonzalo Bautista, governor of the State of Puebla, and piloted by Captain Luis Martel and Lieutenant Carlos Cortez, of Puebla's aviation school.

The air around the volcano in late afternoon proved too dusty for successful aerial observation, but a start early next morning gave almost perfect conditions for observation. We saw Paricutin nestled among dead crater peaks, each of which in past geologic time must have had a few months of life. A great tower of smoke and dust billowed upward, with outbursts about every twenty seconds, showering red-hot pumice on the sides of the cone, which in February began to arise out of what was then a cornfield. Around the cone lay a great lava flow formed during past weeks, while to the northeast could be seen the little village of San Juan Parangaricutiro which is being smothered under several feet of volcanic ash that lies like blackish-brown everlasting snow over everything.

Our little plane buzzed about the erupting cone, keeping away from flying débris that might puncture the wing fabric or unbalance a propeller by an unlucky hit. Both planes twisted and turned for angle photographs that should be helpful to Dr. Graton in interpreting the volcano's geology.

The pilots and I spent eight hours on the previous night making a trip overland, twenty miles by airline but longer by auto, over ash-choked roads and by burro over trails for the last three miles, to the rim of the depression in which the volcano lies. Outbursts of flame lighted the countryside for miles around, and falling incandescent sand outlined the cone. A soft, harmless rain of volcanic sand pattered down as we clambered by volcano light over lava still steaming and hot to the touch.

Our ground and air views of America's latest volcanic blister impressed on us that nature is still building the earth and that study of such infrequent outbursts should give new knowledge of how the rocks of earth were manufactured. Since our food is grown on earth made of these rocks, and since our metals for war and peace come largely from deposits in molten magmas associated with volcanic action, new practical knowledge should come from studies of Paricutin.

As we flew over the Mil Cumbres (Thousand Peaks) region between Mexico City and Morelia, we realized that each of these old cinder cones had its brief days of fire and that although the earth is young here, geologic action was old when man began to record history. There are volcanic cones by the tens of thousands in Mexico, yet only one other eruption like Paricutin is recorded. That was in 1759, when a cone called Jorullo, about fifteen miles from Paricutin, was formed.—WATSON DAVIS.

GLASS WALLS IN HOMES OF THE FUTURE

THE homes of the future with sliding glass partitions that can be made transparent or opaque at will were described by Dr. Alexander Silverman, head of the department of chemistry of the University of Pittsburgh, in an address before a recent meeting of the American Ceramic Society. By sandwiching light-polarizing material in glass, then crossing two plates in a double wall construction, an opaque partition will result. When one of the plates is slid back, the partition will become transparent, permitting light to stream in.

Colored plate glass walls with artistic continuous metallized decorations was another possibility cited by Dr. Silverman. Electricity passing through the decorations would heat the room. Glass floors could be metallized like the walls, or glass foot-warmers designed as hassocks could be used. If additional heat were necessary portable stoves of artistic metallized glass might be designed. "A room at sixty degrees, insuring warm feet and uniform radiation toward the body from all sides, would be more comfortable," Dr. Silverman pointed out, "than to-day's home at seventy degrees or higher."

Glass construction combined with heating elements can also have built-in lights, thus producing attractive heating and illuminating effects. Tempered glass doors, either clear or opaque, may lead from one room to another and cover cabinets and closets. By the recently developed treatment of sheet glass to produce thin etched films only about a molecule thick, almost all reflected light glare can be eliminated.

Although glass plates can be used for both interior and exterior construction, glass brick and hollow tile are likely also to have increased use. The blocks will be produced in various colors, opaque, translucent, transparent. Artistic design will evolve from the more utilitarian approach now used in modern factory construction.

Glass wool will be more widely used for insulation. It is constantly being made lighter and is now available in a form weighing only a half pound per cubic foot. A four-inch layer of glass wool has the heat insulating value of a fourteen-foot concrete wall, it is claimed.

In the temporary housing provided for our Armed Forces in the Arctic regions, porous glass materials, especially wool, are employed to keep out the intense cold. Glass fabrics will also find increasing use in motor generators, in cables, and as battery insulators.

THE PHYSICAL EXAMINATION OF CHILDREN

A PHYSICAL examination of every boy or girl should be made before he or she is granted a work certificate, was stated by Miss Katharine L. Lenroot, chief of the U. S. Children's Bureau, at a press conference in Washington. The "special measures" for the protection of working boys and girls of high-school age called for in President

Roosevelt's proclamation of May 1 as Child Health Day were explained at the conference.

It is estimated that under the stimulus of war, more than 2,000,000 boys and girls between 14 and 18 years of age were employed as of October, 1942. More than 3,000,000 were employed during the 1942 summer vacation. An even larger number is expected to be at work this summer.

The physical examinations, Miss Lenroot explained, are needed to make sure that a child with defects of vision or hearing, with incipient hernia, or with unsuspected tuberculosis or heart disease, is not subjected to work which will further impair his health. Many such children should not work at all. Others might work in certain jobs under careful supervision.

Too long hours of work are another health hazard to boys and girls of high-school age. The child labor laws of 42 states now have a maximum work week of 48 hours or less for workers up to 16 or 18 years in a varying range of occupations. No child under 18, the Children's Bureau maintains, should be permitted to work more than eight hours a day or 48 hours a week either on farms or on other jobs.

Part-time jobs after school should be limited so that the combined hours of school and work do not exceed this total, except that as school is likely to be different from a job and less strenuous, some boys and girls of 16 and 17 may be able to put in a total of 9 hours a day on school and job together.

Some jobs have basic health hazards, such as exposure to lead, carbon disulfide, chlorinated solvents and benzol, which, as Miss Lenroot pointed out, are more dangerous to boys and girls under 18 than to other workers.

ELECTRIC FISH

Electric fish will hardly power war industries, but knowledge of their "shocking" ability may eventually lead to better understanding of how our own nerves work. New research on these strange creatures has just been reported by Dr. R. T. Cox, of New York University, in *The American Journal of Physics.*

Experiments with three small electric eels were first conducted by Dr. Cox and his associates. When the eels were gently prodded, the scientists' instruments recorded quick electrical pulses as high as 200 volts, lasting about two thousandths of a second. These discharges followed each other in trains of three to five. Single weak discharges come from the rear half of the eel; one of them always preceding a train of major discharges, probably serving as a warning signal to enemies.

When an eel discharges from fear of enemies or to obtain prey, it serves as electrical signal for other eels nearby to close in. In fact, it was discovered that eels could be called by producing a current in any manner. When placed in a weak electric current an electric fish swims in the direction of increasing current density, no matter which way the current is going. But in a strong electric current, it swims toward the negative pole.

"This sort of telegraphic communication very likely compensates the electric eel rather well for his partial loss of sight," Dr. Cox states, "the better so in that he commonly lives in muddy water in which the clearest eyes could see no farther than a few feet."

Tests were also made on the largest of all electric fish, Torpedo occidentalis, found off the north Atlantic Coast. Measurements showed a maximum voltage of 220 volts. Peak power of the torpedo was calculated to be a little less than one horsepower per pound of electric organ. These are values for an instant and would be very much less for electric activity over a longer period of time.

ITEMS

Better first aid treatment for burns and wounds is promised by a new methalose gauze dressing developed by Dave Brady, Robert Bauer and Fredrick F. Yonkman, pharmacologists at Wayne University, Detroit. A soothing, healing water-soluble preparation, easily compounded and applied, are the advantages cited in a preliminary report to the American Pharmaceutical Association. Sulfanilamide and sulfathiazole, infection fighters, are dissolved in the chemical, propylene glycol, then added to a solution of alkyl cellulose. Sprayed on loose mesh gauze, this mixture makes a durable elastic pressure bandage. Adhering readily to injured areas, the gauze tends to prevent loss of fluid and plasma proteins. The dressing can be removed at any time by soaking in water or salt solution. Excellent first aid treatment is thus obtained, the researchers point out, without the disadvantages of greasy ointments or astringent precipitants, such as tannic acid, that kill cells in the injured area, thereby delaying healing.

A destructive enzyme which destroys the vital red blood cells during certain diseases may be ever present in our bodies. Ordinarily an inhibitor in the tissues and blood serum holds the enzyme in check. Evidence that this mechanism exists is reported in *Nature* by Brian Maegraith, G. M. Findlay and N. H. Martin, of the West African Force. Certain tissues, such as the lung, liver and kidney, will destroy washed red blood cells suspended in salt solution, the scientists observed. But this action is checked by adding blood serum. Addition of a minute bit of the poisonous chemical, sodium cyanide, or heat application also inhibited blood cell destruction. Men, monkeys and guinea pigs have been used in the experiments. So far it appears that the cell destroyer in an animal acts only on its own species, while the inhibitor will also protect the blood cells of other animals. Discovery of this action, if substantiated, will aid those trying to combat lytic anemias, such as the mysterious blackwater fever to which the armed forces are exposed in tropical areas.

Development of a yeast powder suitable for human food and plans for the first manufacturing plant for its production, to be set up in Jamaica, are announced in reports reaching Washington from England. It was developed from a strain of Torula utilis by Dr. A. C. Thaysen and colleagues, of the Department of Scientific and Industrial Research at Teddington, England. In the *Lancet* the yeast food is described as having a "slight, not unpleasant taste," and as growing rapidly and being a source of good protein as well as all the B vitamins. The first plant for its manufacture is to be set up in Jamaica because of the availability there of molasses on which, with the addition of ammonium salts, the yeast can be

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TESTING AS A PART OF MILITARY CLASSIFICATION

BY THE STAFF, PERSONNEL RESEARCH SECTION, CLASSIFICATION AND REPLACEMENT BRANCH, THE ADJUTANT GENERAL'S OFFICE

GENERAL

THE construction of psychological tests for use in the classification and assignment of Army personnel is a function of the Personnal Research Section of the Classification and Replacement Branch, The Adjutant General's Office, War Department. The Classification and Replacement Branch is responsible for developing procedures for classifying and assigning all men in the Army with the exception of those in the flight crews of the Air Forces; it develops the policies and prepares the regulations which are used by classification officers in the field. An organizational and functional chart (Fig. 1) of the Personnel Research Section accompanies this article.

The two main objectives of classification are to conserve manpower and expedite training; it is a process through which pertinent data concerning each enlisted man are validly obtained and accurately recorded for use as a basis in making the assignment in which he will be of greatest value to the Service. Tests are employed at every stage of the complex classification process which continues throughout each man's military career. The personnel consultant and the classification and assignment officers in the induction stations, the reception centers and the replacement training centers of the Arms and Services, and in the tactical units and posts administer tests as an integral part of classification and assignment. The principal divisions and stages of the personnel classification system are indicated in Fig. 2.

Army needs dictate the types of tests in use. The number of tests of all types used in the Army has steadily increased since the initiation of the present classification system. Current tests and procedures

are of many varieties: written tests, oral tests, performance tests and standardized interviews. In general, tests are designed to be objective, specific and suitable for group administration. Practically all may be scored either by machine or by hand-applied stencils, and, with few exceptions, raw scores can be converted to standard scores and Army grades, which have a common meaning and interpretation throughout the Service. It is important to understand that tests are only part of the classification or selection process and that they are always used in conjunction with ratings made by trained interviewers, commanding officers under whom the man is serving, or, in the case of officer candidates, special boards of selection.

PROCEDURE IN TEST DEVELOPMENT

After the need for a new test has been recognized and the project has been approved for development, the first step in construction is the determination of its type and scope, based on an analysis of the activities or job for which the test will select men. Then test items are written; in this process, technical experts and the technical literature are consulted, and available tests of the same nature are reviewed. After the items have been reviewed, the test is issued in a preliminary form and tried out on a sample Army population similar to that for which it is ultimately intended. Data obtained in this manner are then analyzed to obtain measures of the reliability and validity of the trial test. The difficulty of items is determined, and each is analyzed to determine the degree to which the right answer discriminates between individuals who score highest and lowest on the whole test. The reliability of the test as a whole is computed, generally by the Kuder-Richardson method. Studies of validity are made by correlating the score on the whole test with, and by analyzing the relation of each test item to, an outside criterion such as a rating of job performance or final grades in special Army training. The results of these statistical analyses determine what further work is necessary to develop the final test form and which items should be included.

Once the final test has been reproduced, it is administered to a new sample population for the purpose of standardization. The standardization of Army tests is essentially a process of constructing a framework for the interpretation of test performance which will apply to men at all levels. For tests of Army-wide usefulness, the standard group is selected to represent all levels of performance in the proportion in which they are found in the Service. When a test is constructed to measure a skill specific to some section of the Army, the standard group is selected from that section. On this basis, raw scores are converted to standard scores with a mean of 100 and a standard deviation of 20. Test scores may also be expressed in terms of five grade levels: I—standard scores of 130 and above; II—standard scores from 110 to 129; III—standard scores from 90 to 109; IV—standard scores from 70 to 89; V—standard scores of 59 and below.

In addition to standard scores, some qualifying or critical score may also be necessary, but such a score is often subject to change, depending upon Army needs. For example, qualifying scores may be raised or lowered according to the number of men available for the training involved. After a test is in operation, further checks are made to determine validity under actual operating conditions, to indicate need for revision as conditions change, to study trends in selected populations, and to determine the possible usefulness of the test in other fields. Typical steps in test development are shown in Fig. 3.

TYPICAL TESTS CONSTRUCTED

Army General Classification Test (GCT, Forms 1a, 1b, 1c, 1d). This test of general ability is given at reception centers to all men able to speak and read English. It contains vocabulary, arithmetic and box counting items arranged in spiral omnibus form; it is graded to include all levels of mental ability. The GCT can be administered, including practice time, in one hour.

Mechanical Aptitude Test (Forms MA-1, MA-2, MA-3, MA-4). This test is designed to predict potential success in learning general mechanical duties. The types of items in the four forms vary: MA-1 includes mechanical movements, surface development and shop mathematics; MA-2 and 3 include mechanical information, surface development and mechanical comprehension; MA-4 includes tool recognition, mechanical comprehension and surface development. The first three forms may be scored by parts as well as by the total, and these part scores used in special selection.

Radiotelegraph Operator Aptitude Test (ROA-1, X-1). At the present time, because sufficient operators are not available to the Army, this test is given at reception centers to all men who score above 80 on the General Classification Test. ROA-1, X-1 contains 156 items, each consisting of two code patterns sounded in succession; the man tested is required to decide whether the two patterns are the same (mark YES) or different (mark NO). The items vary in difficulty, and each man tries all of them. The test is available on phonograph records and can be given in this way to groups of 100 to 150 men.

Achievement and Trade Knowledge Tests. Various educational achievement tests are used when there is need for men with knowledge of particular academic subjects. Trade knowledge tests are used to select for special training men sufficiently informed about particular jobs.

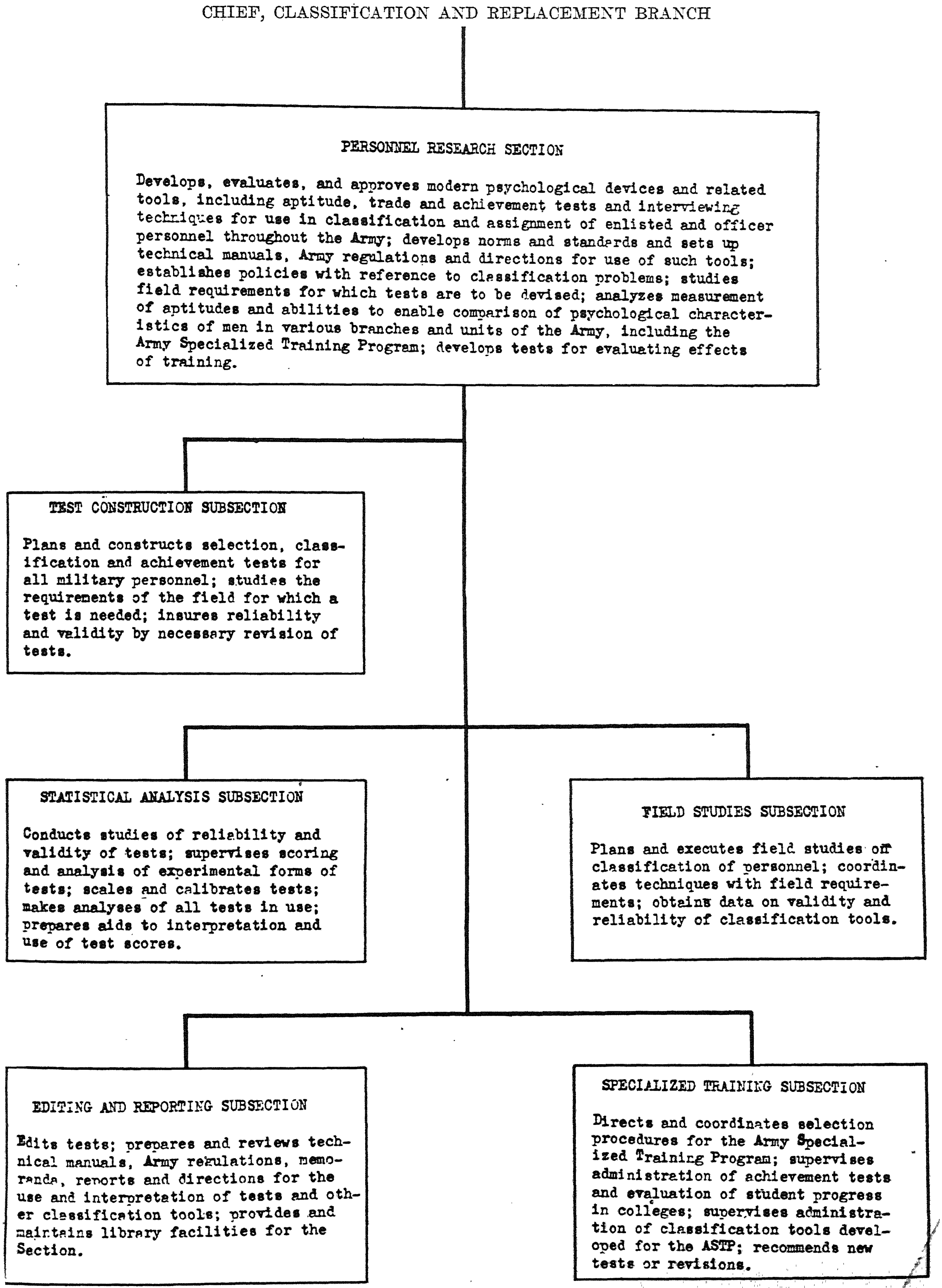
CHIEF, CLASSIFICATION AND REPLACEMENT BRANCH
PERSONNEL RESEARCH SECTION
Develops, evaluates, and approves modern psychological devices and related tools, including aptitude, trade and achievement tests and interviewing techniques for use in classification and assignment of enlisted and officer personnel throughout the Army; develops norms and standards and sets up technical manuals, Army regulations and directions for use of such tools; establishes policies with reference to classification problems; studies field requirements for which tests are to be devised; analyzes measurement of aptitudes and abilities to enable comparison of psychological characteristics of men in various branches and units of the Army, including the Army Specialized Training Program; develops tests for evaluating effects of training.
TEST CONSTRUCTION SUBSECTION
Plans and constructs selection, classification and achievement tests for all military personnel; studies the requirements of the field for which a test is needed; insures reliability and validity by necessary revision of tests.
STATISTICAL ANALYSIS SUBSECTION
Conducts studies of reliability and validity of tests; supervises scoring and analysis of experimental forms of tests; scales and calibrates tests; makes analyses of all tests in use; prepares aids to interpretation and use of test scores.
FIELD STUDIES SUBSECTION
Plans and executes field studies of classification of personnel; coordinates techniques with field requirements; obtains data on validity and reliability of classification tools.
EDITING AND REPORTING SUBSECTION
Edits tests; prepares and reviews technical manuals, Army regulations, memoranda, reports and directions for the use and interpretation of tests and other classification tools; provides and maintains library facilities for the Section.
SPECIALIZED TRAINING SUBSECTION
Directs and coordinates selection procedures for the Army Specialized Training Program; supervises administration of achievement tests and evaluation of student progress in colleges; supervises administration of classification tools developed for the ASTP; recommends new tests or revisions.

FIG. 1

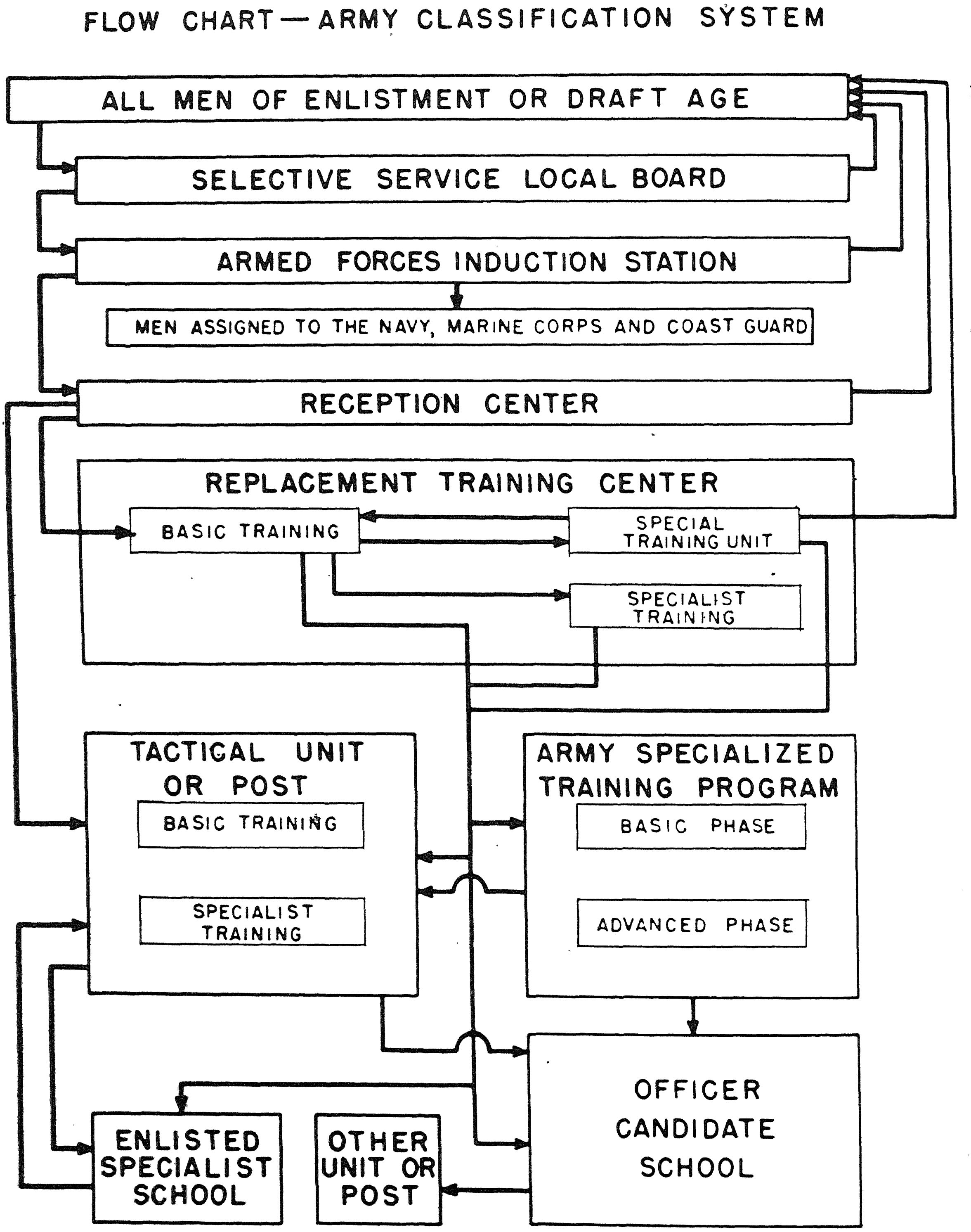

FIG. 2

This chart is intended to illustrate only the major agencies and organizations through which a man may pass or to which he may be assigned in the process of Army classification. Military necessity, local conditions, or special requirements of some arms or services make it impossible to show more than the usual stages involved.

DEVELOPMENT OF TESTS FOR CLASSIFICATION PURPOSES

WORK IN PERSONNEL RESEARCH SECTION | WORK IN THE FIELD

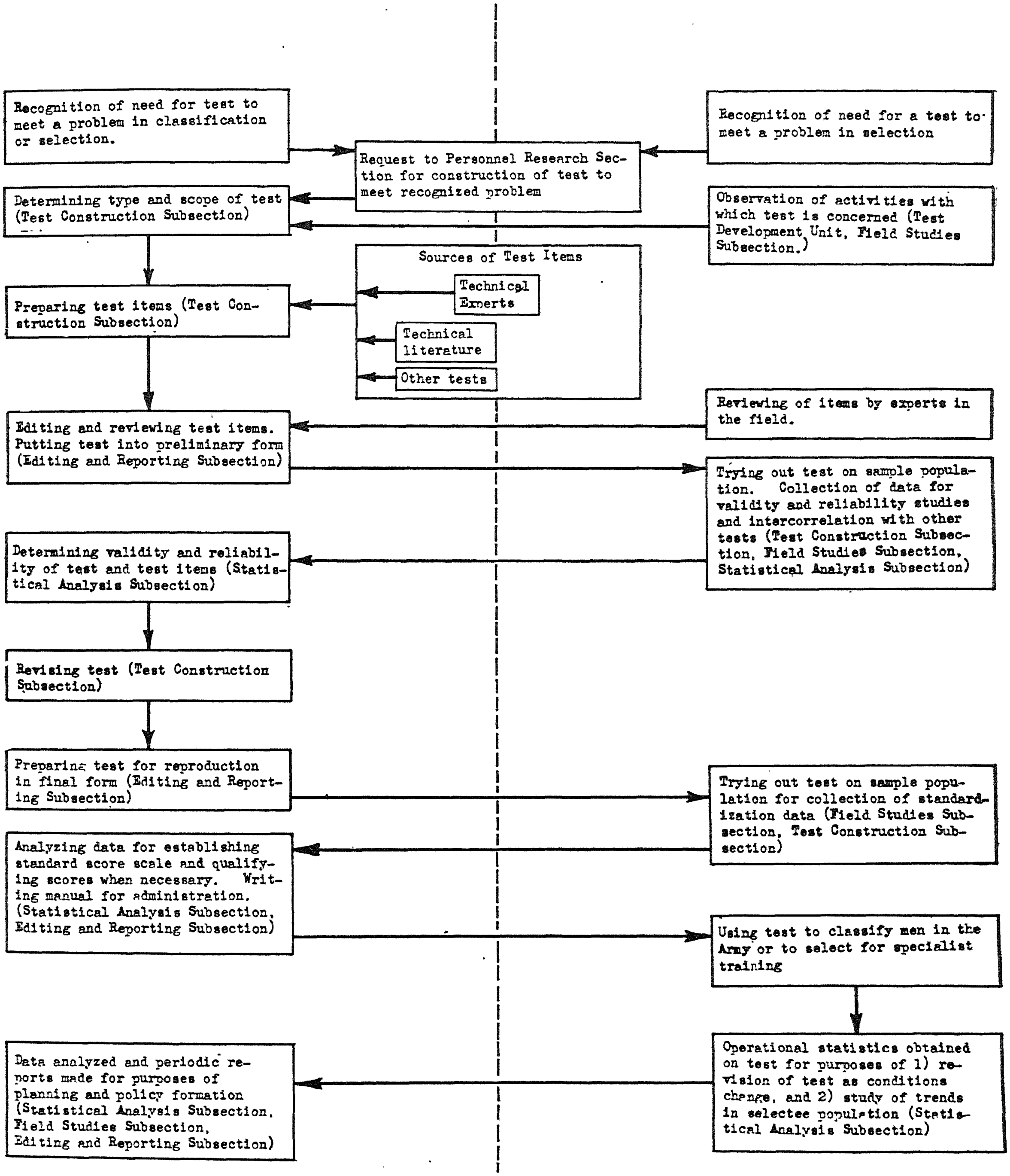

FIG. 3

Tests for the WAAC. Women applying for the WAAC are first given a mental alertness test to screen out the unfit. This test includes six types of items: information, vocabulary, arithmetic, judgment, proverb interpretation and comprehension of graphs and tables. A classification test is later given, in addition to special aptitude and proficiency tests. The aptitude tests used are Mechanical Aptitude, MA-4, Clerical Aptitude, CA-2, X-2, and the Radiotelegraph Operator Aptitude Test ROA-1, X-1. Written and oral

proficiency tests are used to check the technical knowledge of the women in radio repair, automotive mechanics, driver information and other skills.

Warrant Officer Examinations. Examinations of technical ability in approximately thirty technical specialties of warrant officers, including auditing and accounting, supply in various arms, engineering, photography and cryptography, have been prepared. These tests are kept up-to-date to take account of changes in methods and duties incident to the development of the Army.

Army Specialized Training Program Tests. These tests are to assist in the selection of men from among present enlisted personnel of the Army and young men between the ages of 18 and 22 who will be tested after induction and basic military training. Men selected by these tests are eligible for college training in engineering, medicine, chemistry, physics, psychology and foreign languages as part of their Army service. Further tests will be constructed and used periodically to measure their achievement in these subjects.

The following is a fairly complete list of tests developed up to the present time for Army usage:

Classification Tests
- General Classification Test
- Non-Language Test
- Visual Classification Test
- Higher Examination
- Officer Candidate Test
- Women's Classification Test (Mental Alertness Test)
- Army Information Sheet (minimum literacy test)

Aptitude Tests
- Mechanical Aptitude Test
- Clerical Aptitude Test
- Radiotelegraph Operator Aptitude Test
- Code Learning Test
- Battery of Tests for Combat Intelligence
  - Identification of Aerial Photographs
  - Map Identification
  - Route Tracing
  - Battle Maps
  - Perception of Detail
  - Map Reading
  - Map Orientation

Educational Achievement Examinations
- Algebra
- Arithmetic
- English Grammar and Composition
- French
- General History
- German
- Inorganic Chemistry
- Physics
- Plane and Solid Geometry
- Spanish
- Trigonometry
- United States History
- Combined Algebra, Trigonometry and Geometry

Trade Knowledge Tests
- General Automotive Information Test
- General Electricity and Radio Information Test
- General Radio Information Test
- Driver and Automotive Information Test

Warrant Officer Examinations
- About 30 technical examinations

Army Specialized Training Program Tests
- Army Specialized Training Program Test
  - (achievement tests in each subject taught under the program are under construction)

WAR RÔLE OF A GEOLOGICAL SURVEY[1]

By Dr. ARTHUR BEVAN

STATE GEOLOGIST OF VIRGINIA, CHARLOTTESVILLE

THE chief rôle of a Geological Survey in modern industrial society is to get all the obtainable data about all the earth materials in all the domain served by that Survey. To meet the opportunities and obligations of this rôle, each official Survey ideally must get all these data with sufficient accuracy and in adequate detail to satisfy promptly and completely all the conceivable immediate demands. That Survey must also anticipate—even stimulate—the rational future needs of expanding mineral and related industries and interdependent society.

Those earth materials, which are so indispensable to the smooth functioning, and even the existence, of modern society and its industrial and governmental economies, are the familiar daily grist of the technical mills of each Geological Survey, whether provincial, state or national. They include at the base the "precious metals"—precious not in the technical sense but in the social sense that to modern society they are even more precious than gold and silver or rubies and diamonds. Those metals are obviously the birthstones of the "Age of Metals," as well as the structural framework for most industrial achievements. Included also among the grist of a Geological Survey are the essential nonmetals in great diversity, the priceless mineral fuels and sources of power, and, by no means least, the absolutely vital ground-water supplies. They are the functioning "corpuscles" in the "life blood" of modern industry.

[1] Address at the annual meeting of the Association of American State Geologists, Washington, D. C., February 19, 1943.

But it is not enough for a Geological Survey merely to act in the rôle of a general fact-finding agent on the broad stage of modern industrial relations. The interpretive biologist dissects tissues to the nucleus of the cell, or even more minutely, while the exploring physicist literally peers into the structure of the atom to perceive its component parts and its energy mechanisms. Each geologist, worthy of the name "research scientist," on the staff of an alert, aggressive Geological Survey must constantly strive to do likewise. At the same time, the Survey staff in part or as a whole must assemble, coordinate and interpret the results of that research into a body of usable and useful facts. No longer is it sufficient, as it may have been in days of old, to know what earth materials have been stored within the domain of the Geological Survey, and where, and in what probable quantity and of what possible quality. The present uses of those geologic resources must be widely understood and their potential industrial uses, to meet the needs of evolving society, must be envisioned as clearly and as completely as may be possible.

The staff of a modern Geological Survey must examine more or less minutely—take apart, so to speak—many raw mineral resources so as to determine the constituents and their significant geologic and chemical relations. For example, staff technologists must discover the kinds and characteristics of the unit components of coals, clays, even limestones, and of other complex earth materials. More than that, with this precise technical knowledge well in hand, they should experiment to the end that ways and means may be found to separate the constituents and recombine them into products of greater usefulness and hence of more value to society.

In summary, as I see it just now, the rôle of a Geological Survey has advanced rapidly from the qualitative stage of research to the quantitative theater of investigation. Early tendencies, entirely necessary and appropriate in those times, to general reconnaissance research in the field and in the laboratory have given way to precise, particular research in specialized fields through the use of all the available specialized techniques and apparatus. Pure geologic research, for a Geological Survey, has been supplemented to a considerable degree by emphasis upon greater practical usefulness. It should be stressed, however, that the two fields are not mutually exclusive, popular notions to the contrary notwithstanding, but that they are mutually interdependent.

In playing its proper rôle in modern society, a Geological Survey not only has the opportunity and obligation to make available to industry, in the broadest sense, all the useful facts about geologic resources, but it has also an unparalleled opportunity and an inescapable obligation to keep public interest stimulated and public opinion informed in regard to these resources. Some of us call this rôle of a Geological Survey "PEG"—alphabetical jargon for public education in geology. It is a responsibility and an opportunity of tax-supported Surveys even more than it is of educational institutions. The knowledge and attitude of the present and oncoming generations of public-minded citizens, administrative officials and statesmen in regard to the interrelated aspects of geologic resources will be of consequential significance in helping to shape the destinies of the post-war world and in making that world a better and more comfortable place in which to live and to create worthy results. The idea is well expressed in two recent statements: one by State Geologist Smith of Michigan when he said, apropos of PEG, that "geology should come 'down to earth' "; the other by Miss Newlon, of the West Virginia Geological Survey, when she emphasized one of the aims of their Survey to be that "every one in this State is going to know what geology is and what it's good for!"

At the risk of becoming wearisome in the emphasis upon PEG as part of the essential rôle of a Geological Survey, it should still be stressed in these times of rapid tempo that grave social dangers may lurk in the long-continued public lack of understanding, or even worse—misunderstanding, of the rôle of pure and applied geology in modern affairs. Examples ranging from local to national importance no doubt come readily to mind. Too many steps of progress in geological science, industrial development, governmental functioning and social evolution depend upon those influential public attitudes to permit us to dismiss them as of little concern to the research geologist, the teaching geologist and staff members of official Geological Surveys.

Most of you are probably asking by this time, "But what has all this to do with the rôle of a Geological Survey in time of war?" Only this: Wars make rapid and decisive shifts mandatory—not only in the military establishment but in the undergirding and supporting civilian activities. In an all-out, global war, such as the present conflict, many of those civilian shifts are sudden and drastic. In brief, Geological Surveys too have gone to war—in many ways and over a considerable period of time. In the field and laboratory work and in the strengthening of their staffs, most of them have been preparing, though probably without this particular objective in the forefront of their planning, to meet promptly the emergency demands that are now being made upon them by the armed services and by war industries. Some technical staff personnel have gone into the armed services

where their special knowledge and skills will be of the greatest use in the successful prosecution of the war; others remain on the local "home front" where the daily service they render is just as highly important and just as effective in the war efforts.

Illustrations multiply daily in the experience of each Geological Survey as to how dependent upon the broad base of geologic science—pure and applied—is the successful conduct of a large-scale modern war. In fact, the turn of the wheel of fortune in great measure is as closely related to geologic science as it is to military science, though the latter is without question the more directly involved and the more directly responsible. It is so obvious now as to be trite that this is a war of machines and instruments, of terrain and topography, of mineral resources and ground-water supplies—all geologic resources of the greatest importance. This is no minimization of man power, or of the value of brains compared with brawn, but under modern conditions they are not the unique force of ancient warfare. The unfortunate fact still remains, however, that the supreme value of geologic resources has not been clearly understood or readily accepted by all who are concerned with all the theaters of preparation, of potential conflicts of interest and of actual combat. "Too little too late" also has its dismaying applications here as well as elsewhere.

The war rôle of an efficient Geological Survey appears, therefore, to be primarily an accelerated continuance of its best peacetime methods. A decisive shift in emphasis upon the type of results to be obtained and their application—both in time and place—rapidly becomes necessary, or even mandatory. Some temporary measures will be desirable, but ultimate peacetime good may come from some of them. The war rôle of an official Geological Survey thus involves a shift in immediate objectives, a new setting of the sights and probably also a realignment of personnel.

In conclusion, we must never forget, or permit others to overlook, the facts that those Surveys are the great repositories of the most useful and diversified geologic and mineral resource data, that they are the users of the most modern field and laboratory techniques in their respective spheres, and that above all they have the technically trained, skilled personnel to make effectively the necessary conversion from peacetime scientific and industrial research to frontal attacks upon very important war problems. Obviously, the closer the cooperation with all other agencies having similar rôles, the more effective will be the contributions of the Geological Surveys toward the prompt and effective winning of this war. Unselfish continuance of such effective cooperation far into the post-war period should help to make another such war virtually impossible.

OBITUARY

ISAAC MCKINNEY LEWIS
1878–1943

ISAAC MCKINNEY LEWIS, professor of bacteriology in the University of Texas, died of a heart attack on March 12, 1943. He had suffered an attack in the summer of 1941, but, after a long convalescence, he had apparently fully recovered. He is survived by two brothers, Dr. Charles E. Lewis, of Waterville, Maine, and John R. Lewis, of Wolcott, Indiana. He never married.

Dr. Lewis, third son of Isaac R. Lewis and Margaret Jane (McKinney) Lewis, was born on September 21, 1878, on a farm in Jasper County near Rensselaer, Indiana. He had the misfortune never to know his father, who died in the May preceding his birth. He was devoted to his mother, who had been a teacher, throughout her lifetime and he gave her credit for instilling in him the desire to secure an education.

He attended the country school near his home and finished the eighth grade at the age of fourteen. By home study while working on the farm he prepared himself for the teacher's certificate, and at the age of seventeen he began teaching in his home township of Barkley. In 1897 he entered the Indiana State Normal School. His work there was interrupted by trouble with his eyes following measles, and by the necessity of earning his expenses, but he was finally able to finish in 1904. He entered the University of Indiana in the fall of the same year and from this institution he received the B.A. in 1906, the M.A. in 1907 and the Ph.D. in 1909. During the year 1908–09 he was instructor in botany in New Hampshire State College and assistant botanist in the experiment station. In September of 1909 he came to the University of Texas to be instructor in botany and to initiate work in bacteriology. He rose through the successive ranks to professor in 1919. In 1918–19 he was a captain in the Sanitary Corps, U. S. Army, stationed at the Yale Army Laboratory School. He was designated as research professor in 1938–39. For a number of years he taught both botany and bacteriology, but the development under his leadership of the work in bacteriology was such that for the past fifteen years this field occupied his entire time. Throughout his career, however, he retained an intense loyalty to the parent science of botany.

As a man he was unselfish, kindly and modest almost to the point of shyness, with a lively sense of humor

and a ready wit. Friends, colleagues, students found him easily approachable, sympathetic, and in times of trouble generous with financial aid.

As a teacher Dr. Lewis was excellent. His lectures, sound always in matter, were invariably well organized, well presented and highly interesting. Students trained under him were warmly welcomed if they transferred to another institution. Among his associates it has been a common experience to be told by former students that Dr. Lewis was the best teacher they had during their college career, either at the University of Texas or elsewhere.

He was a member of Sigma Xi, the American Association for the Advancement of Science, the Botanical Society of America, the American Phytopathological Society, the American Microscopical Society (vice-president, 1932), the Society of American Bacteriologists and the Texas Academy of Science. In the Society of American Bacteriologists he was a member of the national council from 1940 to 1942. He was the organizer of the Texas Branch of that society, and at the time of his death was serving his second term as its president.

In productive scholarship Dr. Lewis was painstaking and tireless. Few of his publications show joint authorship, for he preferred to work alone, even to the point that he prepared himself most of the media and glassware. Each experiment he repeated many times over before he accepted the results. It is plainly evident from a consideration of his publications that his primary interest was in the pure and fundamental aspects of the subject. And the caliber of the work done by him is attested by the letters of commendation which he received from foreign and American bacteriologists. At the time of his death he was engaged in the preparation of the manuscript for a book on the bacterial cell.

O. B. WILLIAMS

RECENT DEATHS

DR. HENRY SEELY WHITE, professor emeritus of mathematics of Vassar College, died on May 20 at the age of eighty-two years.

JOHN S. STONE, from 1920 to 1935 a member of the department of research and development of the American Telephone and Telegraph Company, died on May 20 in his sixty-fourth year.

ELIZABETH T. PLATT, since 1937 librarian of the American Geographical Society of New York, died on May 22 at the age of forty-three years.

SCIENTIFIC EVENTS

EXPLORATIONS AND FIELD WORK OF THE SMITHSONIAN INSTITUTION

THE annual report for 1942 by Dr. Charles G. Abbot, secretary of the Smithsonian Institution, gives the following account of explorations and field work carried out during the year:

Explorations, often in out-of-the-way corners of the earth, have always formed a major part of the institution's program for the "increase and diffusion of knowledge." Although world conditions during the past year have made it either impracticable or undesirable to send out many of the expeditions that normally would have taken the field, nevertheless, even under the present unfavorable conditions it was found possible to carry on some field work in connection with researches previously commenced.

In astrophysics, field observers carried on their study of the intensity of solar radiation at the three Smithsonian observing stations on Mount Montezuma, Chile, Table Mountain, Calif., and Burro Mountain, N. Mex. Observations were made on every suitable day throughout the year, and the results were transmitted to Washington where they are used in investigations on the variability of solar radiation and on the relation between this variability and the earth's weather.

In geology, Dr. W. F. Foshag directed an expedition in cooperation with the U. S. Geological Survey with the purpose of studying certain strategic-mineral resources of Mexico. Dr. Charles E. Resser continued his studies of Cambrian rocks from Montana into the Canadian Rockies, obtaining much new information and many desirable specimens pertaining to the ancient Cambrian period. Dr. G. Arthur Cooper made large collections of Carboniferous and Permian fossils in Texas and Oklahoma, including much material hitherto lacking in the National Museum collections. A third expedition to the Bridger Badlands of southwestern Wyoming in search of extinct vertebrate animals was directed by Dr. C. Lewis Gazin; many interesting exhibition and study specimens were brought back to the museum, including a 1,270-pound slab containing 12 or 13 fossil turtles.

In biology, Dr. E. A. Chapin visited the island of Jamaica to continue his studies of the insect fauna with special reference to the termites. Large collections of the plants of Cuba were made by C. V. Morton, who spent two months on the island in botanical field work accompanied by two Cuban Government botanists.

In anthropology, Dr. T. D. Stewart visited Peru to make a scientific examination of the skeletal remains exposed in the numerous ancient cemeteries of that country; he also gathered information on the skeletal collections in Peruvian museums. As an extension of Smithsonian cave explorations in the Big Bend region of Texas, Walter W. Taylor investigated caves in the region of Ciénegas, Coahuila, Mexico, some twenty caves being excavated in the course of the work. Dr. Frank H. H. Roberts, Jr., conducted archeological investigations near the town of San Jon, eastern New Mexico, revealing four types of projectile points from four stratigraphic horizons, the

oldest type in association with an extinct bison and with indications that it may be contemporaneous with the Folsom horizon. Dr. William N. Fenton recorded Iroquois songs in New York State and Canada in cooperation with the Division of Music in the Library of Congress.

THE PATENT INDEX FOR CHEMICAL ABSTRACTS

THE chairman of the Science-Technology Group of the Special Libraries Association has sent the following announcement to SCIENCE:

Some years ago a committee of the Science-Technology Group of the Special Libraries Association started an index of the patents for *Chemical Abstracts* by country and by patent number thereunder, to conform with the present index issued yearly since 1936 by *Chemical Abstracts* itself. Many of the librarians, particularly those working with patent literature, felt that this project was extremely worthwhile and that the publication would be of interest to many firms working with chemical patents, as well as to libraries.

The Patent Index for *Chemical Abstracts*, 1907–1936, is practically completed. The patents for the year 1936 have been included because the next decennial index will carry a patent number index beginning with 1937. Thus, this publication will serve to make the index of patents to *Chemical Abstracts* complete.

Since the material is chiefly a numerical listing, the type-setting for which would be extremely expensive, it seemed to the committee that some form of photographic reproduction would be the most satisfactory method of publication and, for this reason, they have arranged with Edwards Brothers, Inc., of Ann Arbor, Mich., who are publishing Beilstein and a number of other German scientific and technical books for the Alien Property Custodian, as well as the Library of Congress Catalog of Printed Cards, to consider the practicability of publishing this index by the photo-offset process. It is estimated that the index will fill approximately 500 pages, the same page size as *Chemical Abstracts*.

Since the demand for this publication is definitely limited and may even be insufficient to warrant publication, it is suggested that any one who would be interested in purchasing one or more copies of the index should write either to Miss Elsie L. Garvin, chairman of the Science-Technology Group of the Special Libraries Association, at the Eastman Kodak Company Research Library, Kodak Park Works, Rochester, N. Y., or directly to Edwards Brothers, Inc., of Ann Arbor, Mich.

THE TRANSACTIONS OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA

WE learn from T. T. Colquhoun, honorary secretary of the Royal Society of South Australia, that at a recent meeting of the council it was decided that, for various reasons, it was desirable to suspend general dispatch of the *Transactions* overseas for the duration of the war. It was felt, however, that a skeleton distribution should be maintained in order that the publication may be available to research workers in the United States. A small list of learned societies and libraries on the exchange or subscription list was therefore drawn up and it was decided to forward the *Transactions* to these as they are issued. These societies are:

American Chemical Society, Columbus, Ohio.
American Microscopical Society, Manhattan, Kansas.
Arnold Arboretum, Harvard University, Jamaica Plain, Mass.
Botanical Gardens, St. Louis, Mo.
Field Museum of Natural History, Chicago, Ill.
Marine Biological Laboratory, Woods Hole, Mass.
National Academy of Sciences, Washington, D. C.
New York Public Library, New York, N. Y.
Smithsonian Institution, Washington, D. C.
U. S. Department of Agriculture, Washington, D. C.
U. S. Geological Survey, Washington, D. C.
University of California, Berkeley, Calif.

RARE CHEMICALS

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.:

1. Chromium wire or ribbon
2. Sodium hypophosphate or any acid sodium hypophosphate
3. 2,4,6-trisulphydryltriazine
4. alpha-methyl-vinyl-methyl-ketone
5. Ornithine
6. Di-n-propyl aminoethyl alcohol
7. Dibromoacetic acid
8. Glyoxylic acid
9. Long chain sulfonium, such as lauryl diethyl sulfonium iodide
10. Desoxy ribose
11. Triethyl phosphene
12. Pure arsenic
13. Cupric or cuprous oxide (pure)
14. Cupric or cuprous sulfide (pure)
15. Molybdenum tetrabromide
16. Acetyl sulfanilic chloride
17. Lithium lactate
18. Orthoform (new and old)

THE MOBILIZATION OF SCIENCE

THE following resolution was passed on May 8 by the War Policy Committee of the American Institute of Physics concerning the Kilgore bill.

WHEREAS, The American Institute of Physics, representing the physicists engaged in all branches of activity in their profession, has made studies and surveys to determine the extent to which physicists are engaged in and contributing to the war effort; and

WHEREAS, The facts thus found show that practically all physicists are now applying themselves to the advancement of war research, war industry, and training personnel for the war effort; therefore be it

Resolved, That the War Policy Committee of the American Institute of Physics, while conceding that there is room for improvement, nevertheless maintains that physics is well mobilized and is effectively working on the problems arising out of the war through such agencies as the Office of Scientific Research and Development; the laboratories of industry and of the various branches of the armed services and other government agencies; and in the laboratories and classrooms of our educational institutions where large numbers of personnel are being trained for war service; and be it further

Resolved, That the War Policy Committee of the American Institute of Physics regards the proposals now before Congress in the forms of Senate bill No. S. 702 and House bill No. H.R. 2100 as not well conceived to increase the productivity of physics in the war, but rather tending to disorganize and retard the effective work now being done.

PRESENTATION OF THE CHARLES FREDERICK CHANDLER MEDAL

The Chandler Medal for distinguished service in science was presented on May 24 at Columbia University to Dr. Willard H. Dow, president and general manager of the Dow Chemical Company, Midland, Mich. The medal was awarded in recognition of "his dynamic and successful leadership in the American chemical industry. In addition to his accomplishment in expanding a chemical industry which depended upon Michigan salt brines, his daring enterprise in the direction of the extraction of bromine and of magnesium from sea water, the production of synthetic plastics and synthetic rubber has attracted world-wide attention." After the presentation Dr. Dow delivered the medal address, which was entitled "Rediscover the Rainbow."

Dr. Dow was born in Midland on January 4, 1897. He was graduated from the University of Michigan with the degree of bachelor of science in chemical engineering in 1919. He received the honorary degree of doctor of science from the Michigan College of Mining and Technology in 1939 and the honorary degree of doctor of engineering from the University of Michigan in 1941.

His career as chemical engineer began in 1919 with the Dow Chemical Company. He became assistant general manager in 1926, and has been president and general manager since 1930. He is president of the Ethyl-Dow Chemical Company, which operates a plant for the recovery of bromine from the sea at Kure Beach near Wilmington, N. C. In addition he is president of the Midland Ammonia Company and of the Dow Chemical Company of Canada, Limited. He is a director of the American Chemical Society and a member of the Advisory Board of the Chicago Chemical Warfare Procurement District.

The Chandler Medal was established in 1910 in honor of Professor Charles Frederick Chandler, pioneer in industrial chemistry and a founder of the American Chemical Society. It is awarded annually from a special fund administered by the trustees of Columbia University. There have been nineteen previous recipients of the medal. The last award was made in 1942 to two brothers outstanding in chemical science, Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories of New York, and Professor Roger J. Williams, of the University of Texas.

Professor Arthur W. Thomas was chairman of the committee of award. Other members were Professors Leo H. Baekeland and Arthur W. Hixson.

SCIENTIFIC NOTES AND NEWS

Dr. J. Murray Luck, secretary of the Pacific Division of the American Association for the Advancement of Science, telegraphs that the Corvallis, Oregon, meeting, which was to have been held from June 14 to 19, has been cancelled. He states that unanticipated difficulties in the arrangements for lecture rooms and meals necessitated this action. The transfer of the meeting to another institution did not prove feasible.

In recognition of distinguished attainment and outstanding contribution to the advancement of coopèrative research in fundamental geophysics, Dr. Oscar Edward Meinzer is the recipient of the fifth annual award of the William Bowie Medal by the American Geophysical Union.

Among the medals presented on May 19 by the National Institute of Social Sciences, a gold medal was given to Dr. Edwin G. Conklin, of Princeton University, president of the American Philosophical Society. The citation reads: "In recognition of your distinguished service for the benefit of mankind through your fundamental contributions to science and education. Your lifelong studies and attainments in the fields of biology and zoology acclaim you among the truly great throughout the scientific world to-day."

The Jacob F. Schoellkopf Medal for 1943 of the Western New York Section of the American Chemical Society has been presented to Raymond R. Ridgway, associate research director of the Norton Company, Chippewa, Ontario, in recognition of the development of boron carbide as an industrial abrasive.

The Willard Gibbs medal, founded by William A. Converse, was presented on May 20 to Dr. Conrad Arnold Elvehjem, professor of biochemistry at the University of Wisconsin, by the Chicago Section of the American Chemical Society at a dinner meeting at the Medinah Club of Chicago. The medal is awarded annually in special recognition of "eminent work in and

original contributions to pure or applied chemistry." The recipient is chosen each year by a jury appointed by the Chicago section. The achievements for which the medal was awarded to Dr. Elvehjem are given in the issue of SCIENCE for February 19. Dr. Roy C. Newton, chairman of the Chicago section and vice-president of Swift and Company, spoke on "The Willard Gibbs Medal, an Inspiration to Chemists." Dr. C. Glenn King, scientific director of the Nutrition Foundation, spoke on "The Medalist, His Achievements," and Dr. Per K. Frolich, president of the American Chemical Society, presented the medal. Dr. Elvehjem's address was entitled "The Nutritional Significance of the Newer Members of the B-Complex."

AT the annual dinner meeting of the Board of Directors of the National Science Fund of the National Academy of Sciences held in New York City on May 19, Dr. Charles Huggins, professor of surgery at the University of Chicago, was presented with a $2,000 award, given by Dr. Charles L. Mayer and administered by the National Science Fund. The award was made for the most outstanding contribution during 1942 to present-day knowledge of factors affecting the growth of animal cells with particular reference to human cancer, and as a new type of prize for the advancement of fundamental scientific research administered under a new type of philanthropic foundation. It was announced by Dr. William J. Robbins, chairman of the fund, that a second Charles L. Mayer Award of $2,000 in the same field will be made in 1943 and that entries and recommendations for the consideration of the Advisory Committee should be in the office of the National Science Fund, 515 Madison Avenue, New York City, by January 15, 1944. He also reported that early announcement would be made of a $4,000 award to be offered for a significant study in the field of physics.

DR. CHARLES FREDERICK BOLDUAN, having reached the civil service age limit, will retire on June 1 after serving for twenty-nine years as director of the Bureau of Health Education of the Municipal Department of Health of New York City which he organized and of which he was the first director. Fellow-employees and friends in the medical profession outside the department gave a testimonial dinner on the evening of May 13. The speakers included Dr. James Alexander Miller, chairman, and Dr. E. H. Lewinski-Corwin, executive secretary of the committee on public health relations of the New York Academy of Medicine; Dr. Haven Emerson, member of the City Board of Health and former Health Commissioner, and bureau heads of the Department of Health.

A TESTIMONIAL dinner was tendered by various institutions with which he has been associated to Dr. J. Stanley Kenney, president of the Medical Society of the County of New York, on May 19. The speakers included Dr. Thomas A. McGoldrick, president of the Medical Society of the State of New York; Dr. Nathan B. Van Etten, past president of the American Medical Association; the Honorable Joseph V. McKee, formerly judge of City Court in the Bronx and formerly mayor of New York City; Dr. Edward M. Bernecker, Commissioner of Hospitals; Dr. Ernest L. Stebbins, Commissioner of Health; Dr. Alexander Nicoll, Lieutenant Colonel, World War I, commanding officer of Red Cross Hospital Unit H of Fordham Hospital, with which organization Dr. Kenney served in France during the last war. Dr. John J. McGowan, medical director of Fordham Hospital, was toastmaster.

SMITH COLLEGE conferred the doctorate of science at its commencement exercises on May 20 on Helen Woodard Atwater, of the U. S. Department of Agriculture, editor of the *Journal of Home Economics*, and on Dr. Marion Hines, associate professor of anatomy in the School of Medicine of the Johns Hopkins University. The degree was conferred on Miss Atwater for "devoting her life to the development of national interest in a better knowledge of the value of food," and on Dr. Hines in recognition of her "brilliant researches in the anatomy and physiology of the nervous system."

C. R. DE LONG, consulting chemical engineer, was elected president of the Chemists Club, New York City, at its annual meeting on May 5. Mr. De Long succeeds Walter S. Landis, vice-president of the American Cyanamid Company.

THE following officers of the University of Southern California Chapter of the Society of the Sigma Xi for the year 1943 were elected at a meeting of the chapter on May 11: *President,* Dr. Francis Marsh Baldwin, zoology; *Vice-president,* Dr. Arthur W. Nye, physics; *Secretary,* Professor W. W. Smith, bacteriology, and *Treasurer,* Professor Sidney Duncan, engineering. At this meeting the class for 1943 was initiated and a lecture was delivered on "Tropical Diseases and the War" by Professor John Kessel, of the department of bacteriology.

LORD MORAN was re-elected on April 19 president of the Royal College of Physicians of London.

DR. J. EDWARD HOFFMEISTER, professor of geology at the University of Rochester, has been named dean of the faculty of the College of Arts and Science.

DR. JOHN L. SYNGE, F.R.S., professor of applied mathematics and head of the department of the University of Toronto, will join the faculty of the Ohio State University on July 1 as chairman of the department of mathematics. He succeeds Professor Harry W. Kuhn, who retires this summer. Professor Kuhn

has been a member of the university staff continuously since 1901, and has been chairman of the department of mathematics since 1926.

DR. SAMUEL SOSKIN, director of metabolic and endocrine research at the Michael Reese Hospital, Chicago, has been appointed medical director. This inaugurates a new program of medical teaching at that institution. It will be developed first on an intramural basis, and will then gradually merge into postgraduate teaching available to the medical profession at large. It is hoped that the program will be sufficiently advanced by the end of the war to help to meet the demand for refresher courses for physicians now in the armed forces. The hospital is able to draw upon its Research Institute and extensive full-time staff for teachers of the basic sciences to supplement its clinical teaching staff. Dr. Soskin, who will organize the teaching faculty of which he will be dean, originally came to the hospital from the University of Toronto, where he worked with the late Professor J. J. R. Macleod. He is also professorial lecturer in physiology at the University of Chicago.

DR. STERLING BRACKETT, assistant professor of public health in the School of Public Health of the University of North Carolina, has been appointed malariologist in the Stamford Research Laboratories of the American Cyanamid Company.

DR. ARNOLD D. WELCH, who since June, 1940, has been in charge of the pharmacological research laboratories of the Medical-Research Division of Sharp and Dohme, has been made director of research for this division. He will continue to direct the general activities of the pharmacological and nutritional laboratories. Dr. Karl H. Beyer, who recently joined the Medical-Research Division, has been appointed assistant director of pharmacological research. Dr. Beyer will have the cooperation and assistance of Dr. Paul A. Mattis, who is actively supervising the histological and toxicological work of the department and who will also serve as assistant department manager.

ALFRED C. WEED, curator of fishes at Field Museum of Natural History, Chicago, has retired.

DR. T. C. SCHNEIRLA, associate curator of animal behavior at the American Museum of Natural History, has been appointed editor for the Section of Animal Behavior of *Biological Abstracts*.

PROFESSOR ARTHUR M. CHICKERING, Albion College, expects to spend the greater part of the coming summer in the Museum of Comparative Zoology of Harvard College engaged in the study of Panamanian spiders.

DR. HERBERT M. COBE, of the department of bacteriology of Temple University Professional Schools, Philadelphia, has been granted leave of absence for the duration of the war to accept a commission as First Lieutenant in the Army of the United States. He is stationed at Fort Devens, Mass.

THE James Arthur Lecture of the American Museum of Natural History on the evolution of the human brain was given on May 27 by Dr. James W. Papez, professor of anatomy at Cornell University. He spoke on "Ancient Landmarks of the Human Brain and Their Origin."

SIR LAWRENCE BRAGG, Cavendish professor of experimental physics in the University of Cambridge, left late in April for Sweden, where he planned to give a series of scientific and popular lectures under the auspices of the British Council. He will give popular lectures on "Seeing Ever Smaller Worlds" and on "Metals," and scientific lectures on "X-Ray Optics," on "The Structure of a Protein" and on "The Strength of Metals."

THE Southeastern Section of the Botanical Society of America, acting through its committee on activities, has cancelled the 1943 summer meeting, normally held in June. The membership voted unanimously, by mail, to retain all present officers until a meeting is next held. These officers are: Dr. O. E. White, University of Virginia, *Chairman;* Dr. K. W. Hunt, College of Charleston, *Secretary;* Dr. S. L. Meyer, University of Tennessee, Dr. F. A. Wolf, Duke University, and Dr. G. T. Weber, University of Florida, *Committee on Activities.*

DISCUSSION

IS WAR THE PROGENY OF SCIENCE, OR SCIENCE THE PROGENY OF WAR, OR ARE BOTH OF THESE SUPPOSITIONS FUNDAMENTALLY FALSE?

MANY answers are given as to what has brought about the present crisis. Most of them are wrong. Some say pressure of population! Wrong! To see how wrong it is only necessary to call attention to the fact that all the aggressors are trying to stimulate the birthrate in their countries. Others say needed access to raw materials! Wrong! for there has never been any lack of such access for non-aggressor nations.

Denmark had the highest standard of living in Europe and she had almost no raw materials but had no trouble in getting what she needed through the normal processes of trade. Some say that science must be held responsible, since it has made possible the development of the instruments of destruction and created the conditions that bring on these clashes. They say that man's moral development has not kept pace with his scientific progress. Therefore call a halt to science till morals catch up.

That is how one group talks. Are they right or are they wrong? If they are right, then all institutions of higher learning in the world are wrong in the whole of their objectives, for they consider it their main job to increase and disseminate knowledge, which is only another word for science. They look upon this as mankind's greatest need.

But there is another group that turns the foregoing statement around and asserts, not that science is responsible for war, but that war is responsible for science—that science is the progeny of war, that war has stimulated all the great inventions. Now, it has in fact stimulated some of them, but a reputable writer has recently gone so far as to make the statement that in view of the conditions brought about by modern science a man's life was safer a few hundred years ago than it is to-day.

That is an interesting and an arresting statement which one might possibly think was true if he had somehow been kept in ignorance of the *statistical fact* that the average span of life for all of us to-day is about sixty years, whereas only 150 years ago it was about thirty years.

Again, I have seen it asserted that war begat science because it was the discovery of gunpowder that first taught man that he could get enormous power out of chemical combinations. That assertion also might make a convert of one who was completely ignorant of the following whole series of historic facts: (1) That gunpowder was invented and first used only for peaceful purposes about 850 A.D. by the most peaceful people on earth; (2) that there is no record that it was in any way applied to warfare until 600 years at least after its invention; (3) that the wide application of chemical forces to the relief of human muscles for doing the world's work is a phenomenon of essentially the past 150 years; (4) that that application first began on a serious scale about 1800 A.D., 1,000 years after the invention of gunpowder, with the appearance of Watt's steam engine; (5) that the industrial revolution neither did nor could come about until after the discovery and development in the two centuries between 1600 A.D. and 1800 A.D. of the principles of Galilean-Newtonian mechanics, of which it was itself an outgrowth; and these had nothing whatever to do with war; (6) that I estimate that more than 99 per cent. of the world's development and application of science up to 1914 was actually made, not in the midst of wars, but in the hundred years from 1814 to 1914—in that very century that was so unusually free from major wars that it is generally known as the century of the "Pax Britannica"—a peace made possible because of the beneficent policing of the world by the British fleet; (7) that there is not the slightest *historic* warrant, taking history as a whole, for calling science and technology the offspring of war; (8) that the opposite assertion is a perfect illustration of the fundamental error of getting the cart exactly before the horse.

ROBERT A. MILLIKAN

THE "SCIENCE MOBILIZATION BILL"

THE introduction of this bill, S.702,[1] is a significant event. Senator Kilgore is to be congratulated for appreciating the practical values of science and for being a pioneer in a highly important field of political action. However, only a narrow body of opinion was influential in the preparation of the bill. It professes to advance "the full development and application of the Nation's scientific and technical resources." These have been created by the joint efforts of research workers, educators, inventors, engineers, manufacturers, mechanics, etc. Senator Kilgore and Representative Wright Patman, sponsor of the same bill in the House, H.R. 2100, have courteously circularized members of some of these groups requesting comments.

Opinion of experts is strongly against the bill. Professor William S. Carpenter, chairman of the department of politics in Princeton University, may be quoted: "It is a bill which should be opposed by every scientist and every student of government." Leading objections may be summarized under three heads:

(1) In times past, existing Federal agencies which are carrying on excellent scientific and technical work have been hampered by insufficient funds. Congress ought to consider giving more adequate support to them before undertaking the commitments of S.702—which are in some measure competitive with existing bureaus.

(2) It is the free man's tradition that every proposed law should be examined as to its potential misuse. Clauses in the bill can establish a new "pork barrel" for the benefit of localities rather than of science, subject to arbitrary Executive disposition. Where a Congressman could have no more than a river dredged or a post office built, the proposed new Office of Scientific and Technical Mobilization

[1] SCIENCE, May 7, 1943, pp. 407–412.

might strengthen the party loyalty of a wavering area by planning development of low-grade ore deposits, planting an experimental crop or starting a Federal school.

(3) The bill ought to satisfy the political element interested in suppressing private enterprise and substituting government by administrators who "serve at the pleasure of the President." Not the least contribution to scientific achievement through the centuries has been made by statesmen who have planned and fostered political freedom. Only in a free society can the cooperations and initiatives flourish which generate the unplanned and unforeseeable major advances of science. The bill gives the new office power "To make, amend, and rescind appropriate rules and regulations to carry out the purposes of this Act and all the powers and duties vested in the Office, which rules and regulations shall have the force and effect of law." Since one of the declared purposes is "to promote the full and speedy introduction of the most advanced and effective techniques . . ." and another is "to assemble, coordinate, and develop for use, in the public interest, all scientific and technical data and facilities . . .," there is here a clear avenue for governmental interference with every detail of laboratory, classroom and shop. The assertion of Dr. K. A. C. Elliott and Dr. Harry Grundfest[2] that the bill should not be attacked on the ground of "regimentation" and their comparison of the powerful new office with such limited agencies as the Public Health Service seem naive.

But destructive criticism of this bill is not enough. Science and expertness generally are affected with a public interest. If scientists as individuals persist in ignoring the social responsibilities of science, there evidently is serious risk that objectionable political measures will be improvised. In universities and scientific organizations the innocently selfish leadership of specialists must be supplemented by leadership aware of the world.

JOHN Q. STEWART

PRINCETON, N. J.

STARS IN "AMERICAN MEN OF SCIENCE"

THE note on stars for American men of science by Dr. S. O. Mast appearing in SCIENCE for May 21, 1943, was read with interest.

The suggestion by Dr. Mast that we ask for a vote on the stars in "American Men of Science" by those concerned is a good one. This has already been done. All those who are included in the sixth edition of the directory were asked whether the stars should be included, and a majority voted for their continuation. A minority of those who replied suggested various ways by which the method might be revised. Accordingly, the American Association for the Advancement of Science was asked to appoint, and appointed, a committee, to take up the question, but owing to the war emergency this committee has not been able to meet. In order that there may be continuity it has been decided to use the same method as in previous editions. When the eighth edition comes up for editorial consideration it is hoped that this committee may be able to function, and that the editor be advised as to the best method to carry out the voting.

Much discussion has appeared in SCIENCE and in earlier editions of the directory in regard to the stars. It has been pointed out that there are advantages and disadvantages; but up to the present time, the advantages have appeared to overshadow the disadvantages.

Election to the National Academy of Sciences takes care of rather a small group of scientific workers and the stars in "American Men of Science" make possible a wider recognition of leaders in science in their respective fields.

JAQUES CATTELL,
Editor, American Men of Science

AUTOBIOGRAPHY IN A DEMOCRACY

IN SCIENCE of February 19 under the title "What Price Glory" Professor Warren T. Vaughan of Richmond, Virginia, discusses in an entertaining way the inequal quality and length of many of the sketches which make up that indispensable volume, "Who's Who in America," while in the current SCIENCE (May 21) under the caption "Class Distinction Among American Men of Science" the method of starring 1,000 leading scientists by a sort of popular vote as done in the past five editions of "American Men of Science" is ridiculed by Professor S. O. Mast, of Johns Hopkins University.

Albeit these criticisms have their value as a part of current notation and opinion, yet they need not be taken over-seriously. The compilation of these volumes is a severe task; they are gotten out hurriedly. The publishers must and in a way may fairly depend on the *en masse* result. Both the participants and subscribers find that the final result is effective, meeting the many thousand ever-varying individual uses and needs. All is like the majestic flow of some great river, the Mississippi, for instance, as I remember it when long since doing river and harbor work below St. Louis. "Mark twain"! Certainly we see that those who have reached great distinction may well show a most becoming modesty and shorten their sketches, the main facts of their lives and their achievements being well known to all. Then too, there are facts of importance not easily brought into the average sketch. All of us work forward towards some greater objective and goal, and it must often prove difficult to set forth

[2] SCIENCE, April 23, 1943, p. 376.

facts and problems within the limits available. For myself, I'd like to call out from the mountain top the unequalled educational value of the *Fossil Cycad National Monument* as often and clearly told in SCIENCE. Surely the biographic approach by the law of averages has validity and convenience too. The "International Who's Who" is in its brevity of form in no wise an exception.

G. R. WIELAND

YALE UNIVERSITY

QUOTATIONS

MOBILIZING SCIENCE

THOUGH the public has paid little attention to Senator Kilgore's bill which would set up an Office of Scientific and Technological Mobilization, few recent proposals have been the subject of more controversy. Senator Kilgore wants his proposed office not only to draft all research scientists but to develop science and technology, encourage inventors and guide the President and Congress in scientific matters. The Army, the engineering societies, the trade associations and the directors of industrial research laboratories oppose him almost unanimously. On the other hand, many university professors, some of the higher officials of the War Production Board and a few corporation executives, among them Henry J. Kaiser, see merit in his bill.

Despite assertions to the contrary, scientists and technologists are not fully mobilized. So far as private research is concerned, industry has been left alone, so that we have much competition in the development of plastics, substitutes, processes for making alcohol, synthetic rubber and high-octane gasoline, and ten thousand other items. Except for the Office of Scientific Research and Development under Dr. Vannevar Bush, we have done virtually nothing to unify government, university and industrial laboratories to meet new war needs. Fundamentals are usually avoided. Yet it is out of fundamentals that new procedures emerge, as we have learned from the uses to which the vacuum tube, photoelectric cells, radio, x-rays have been put. The basis for all these was laid by independent scientists and inventors, who too often were rebuffed.

The proposal that Senator Kilgore has made deserves a fair hearing of Congress. Possibly stronger safeguards against the regimentation of industrial research are called for, and possibly Dr. Bush's method of contracting with university and industrial research laboratories for the solution of specific military problems may be just as effective as mobilizing the key research men in the country. Certainly corporations which are engaged in strikingly original and promising work or which are attacking fundamentals should be left alone. Establish Senator Kilgore's office with proper safeguards and it will have its uses as an independent organization which, like the Bureau of Standards or the United States Public Health Service, will conduct research on its account in fields now ignored, with industry pursuing its own way.—*The New York Times*.

SCIENTIFIC BOOKS

OBJECTIVE MEASUREMENT

Objective Measurement of Instrumental Performance. By JOHN GOODRICH WATKINS. 88 pp. Appendix. New York: Bureau of Publications, Teachers College, Columbia University. 1942. $1.60.

DR. WATKINS painstakingly seeks for a measuring stick to be used for the evaluation of playing ability on a musical instrument. He calls attention to the general acceptance of the consideration of musical ability as an innate capacity and deplores the lack of criteria for achievement other than teacher's marks which are known to be quite unreliable. The few sporadic attempts in the construction of achievement tests were found to be limited to sight-singing and vocal performance, and the evidence indicates that no group test of musical achievement has as yet been constructed with the degree of reliability necessary for individual differentiation.

It would have been desirable to indicate in the title of the book the fact that this test is limited to the playing on the cornet, particularly in view of the author's expressed desire for real scientific objectivity.

The study has two major objectives: (1) To determine the possibility of measuring objectivity achievement on a musical instrument. (2) To find out, in a group of performers on such an instrument, the relation between sight-reading ability and technical skill after various periods of study.

The author admits that traits other than sight-reading and technical skill—such traits as involve interpretation, for example— are a vital part of successful performance, but he does not regard such matters as susceptible of objective study. The test is, therefore, limited to what is termed "sight performance and practiced performance on a musical instrument."

To provide a basis for the tests, the cornet was chosen as the instrument to be used for the rather

questionable reason that fine discriminations of pitch were regarded as not of such prime importance as they would be in the case of such instruments as the violin. Such subordination of pitch requirements seems regrettable.

The construction of the performance test for the cornet was handled very carefully and purposefully. Recent methods for the instrument, published in America, were submitted to school music instructors and private teachers of the cornet, to ascertain which of the methods were most widely used throughout the country and how long the average student took to complete each of them.

The criteria which define difficulty come consistently to the foreground, particularly in the preliminary tests.

The musical measure was adopted as the scoring unit, *i.e.,* a measure was counted wrong if any error occurred within it. Such errors were carefully defined in the instructions to insure objectivity of scoring. Yet in deciding what constitutes an error, many musicians will question the criteria which exclude from such errors "pauses between measures no matter how long" and "tones badly out of tune"; for is not the difficulty, even of reading, enhanced by the player's search for perfection in intonation?

Testing with the preliminary forms offered determination of the difficulty levels and the selection of the final forms of the test. It is quoted in the conclusion that a Gestalt is involved in the reading of music and that an organismic interpretation is desirable when experimenting with melodies. It seems almost unbelievable that this same thought is not applied to the measurement of performance by the adjudicator. No provision is made for it whatsoever.

It is wisely remarked that most human skills seem to be distributed normally among the population, and it might be questioned whether all those who have a proper lip control and musculature for a desirable cupmouthpiece instrument take up the cornet or some other member of that family. A like assumption is made with reference to sight performance ability on the cornet being normally distributed. It was found that both sight-reading ability and technical skill develop at greater rates for the first two years than subsequently, the early progress being greater for the latter than the former, while later progress is the same for both. This would seem to indicate that considerable stress is being placed on technique by the teachers of beginning pupils. And now come some sad admissions, in that "above five years the shape of the curves is not reliably determined" and, further, "there is a wide variation in the abilities of different students after any period of study, some having progressed two or three times as fast as others."

The overview and summary offer some pertinent suggestions: (1) Standardized grading of music would be valuable. (2) Teachers spend too little time developing sight-reading ability. The author closes with the hope that the tests themselves will prove useful measures of achievement for the research worker and the cornet teacher. The bibliography quoted is a valuable addition to the little volume.

ABRAHAM PEPINSKY

PEDIATRICS

Advances in Pediatrics. Edited by ADOLPH G. DE SANCTIS. New York, N. Y.: Interscience Publishers, Inc. 1942.

IN starting this new series of books, the editors did not want directly to compete with reviews already in the field. The plan was to obtain articles on subjects which have shown recent advances, by authors who are sufficiently authoritative to write "personalized" summaries rather than mere compilations of abstracts. The aim is, for the most part, attained and should make the book a desirable addition to the library of all pediatricians and many general practitioners.

It is not possible to criticize the book in detail. The article on chemotherapy by B. W. Corey is adequate, but unfortunately was written before the author could properly evaluate sulfadiazine. Furthermore, he recommends sulfanilamid in streptococcal infections when it is clear that other less toxic drugs are equally effective. The discussion of electroencephalography by Major N. Q. Brill shows that much work must be done before electroencephalography reaches the usefulness of electrocardiography. R. E. Gross describes his successful method of operating on cases of patent ductus arteriosus. The knowledge of the important applications of vitamin K in pediatrics is brought up to date by H. G. Poucher. Tow's article on premature infants is somewhat uneven. He does not properly evaluate the recent work on the physiological handicaps of these infants—particularly the work of Gordon and Levine. It is now clear that premature infants can not handle high fat diets, and this fact explains why human milk is not the best food for these babies. Furthermore, failure of absorption of fat explains why high calorie feedings may appear to be necessary for premature infants since high calorie feedings are never necessary when diets low in fat are used. Tow also does not go into the recent work which shows that infants, particularly prematures, have poor renal function compared with that of later life. This explains the high water requirement as well as the susceptibility to acidosis. This knowledge, which was lacking formally, should form a firm basis for regulating the fluid intake. Also there is recent work on

the psychological reactions of babies to food, and as this work develops we may find that giving babies solid foods at a time when they can not mechanically manage them is a cause of some of the adverse reactions at meal time that are so common after the first year.

Hode's discussion of virus infections reveals that research on poliomyelitis and encephalitis has been particularly fruitful. The evidence that the virus is in the stools and that flies may carry the infection is revolutionizing all concepts of the epidemiology of poliomyelitis. Nelson's discussion of tuberculosis reveals really nothing new but gives an excellent summary of modern concepts.

The discussion of endocrinology is particularly disappointing. Apparently clinical endocrinology is still far, far behind the experimental work. There seems little excuse for saying that iodine therapy of toxic goiters leads to exacerbations when continued, since most authorities agree that it merely masks the state of hyperthyroidism. Other errors and improper evaluations are present in this article.

To general biologists and perhaps practitioners, Sabin's article on toxoplasmosis will be the most interesting. He was able to give an almost complete picture of a newly recognized protozoon infection. The organism invades almost all tissues and can occur in a wide variety of hosts. The exact mode of contagion and possible reservoirs of infection have yet to be worked out. The article should enable others to diagnose the cases and thus fill in the gaps in the picture.

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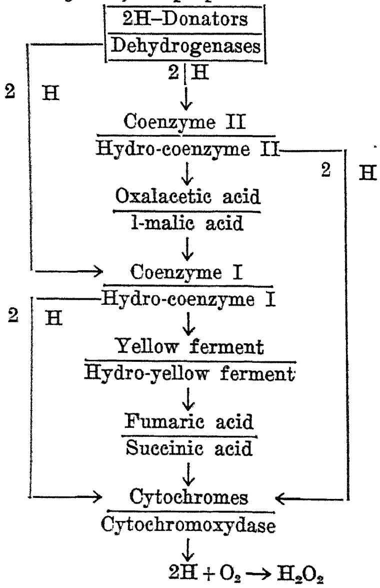
SPECIAL ARTICLES

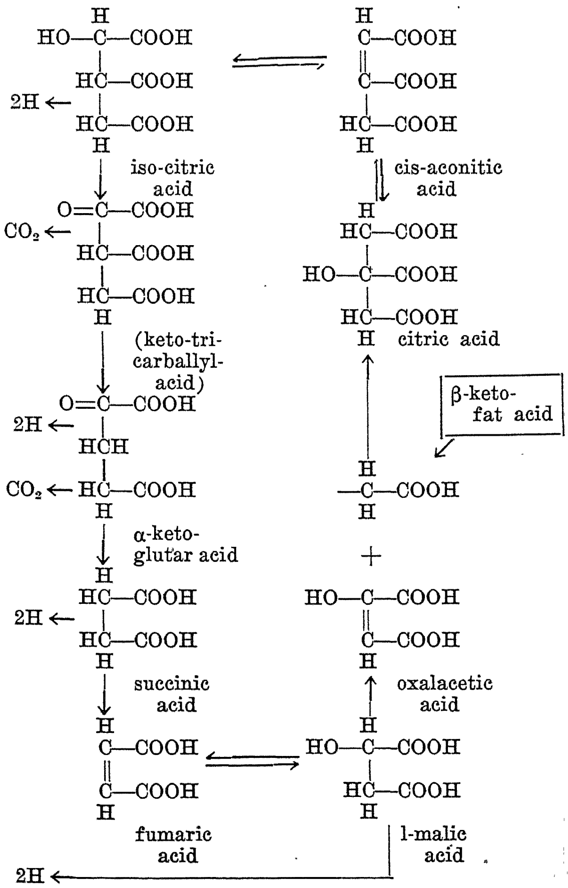
CITRIC ACID CYCLE; SUGAR AND FAT-BREAKDOWN IN TISSUE METABOLISM

KREBS and Johnston[1] suggested the citric acid cycle to be a main link in the breakdown of carbohydrates. I contended that the citric acid was artificially produced under the conditions of their experiments.[2] I have shown that all hydrogen arising from sugar breakdown is either collected with coenzym II and from there transported to oxalacetic acid (so reduced to l-malic acid), or with coenzym I and then transported to fumaric acid (so reduced to succinic acid) and to oxygen.[3] According to Krebs' first opinion all

Hydrogen-transporting system; as proposed 1942



Citric acid cycle



[1] H. A. Krebs and Johnston, *Enzymologia*, 4: 148, 1937.

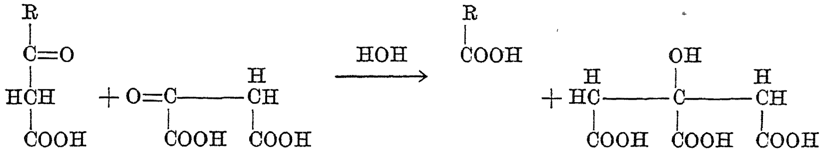
[2] F. L. Breusch, *Zeitschr. für physiol. Chemie*, 250: 262, 1937.

[3] F. L. Breusch, *Enzymologia*, 10: 165, 1942; in print, 1943.

the carbohydrate metabolism passes over the citric acid cycle. Later on[4] he gave the cycle as accounting for only 50 per cent. of the metabolism, saying that for every cycle passed, the oxalacetic acid is reduced three times to 1-malic acid. Krebs is now[5] of the opinion that no citric acid is produced, but cis-aconitic is formed by condensation of oxalacetic acid together with a sugar breakdown product. I have been able[3] to prove that in all organs the velocity of transformation of some of the essential members of the cycle, such as citric acid and α-keto-glutaric acid to 1-malic acid, is only 3–10 per cent. of the velocity of the direct reduction of oxalacetic acid to 1-malic acid. Furthermore, the transformation of oxalacetic acid to 1-malic acid occurs in tissue also anaerobically, whilst the cycle would need large amounts of oxygen, thus definitely showing that the cycle can not play a decisive role in sugar metabolism. My views are confirmed by the work of Thomas,[6] Stare, Lipton and Goldinger,[7] Evans and Slotin[8] and Wood, Werkmann and Hemingway.[9] Perhaps the cycle takes place as a side reaction for breakdown of pyruvic acid.

I found that the pentabromacetone reaction, hitherto employed as an analytical method in all citric acid experiments, is not specific. Acetoacetic acid, always present in tissues, gives the same reaction. This defect can be avoided by five minutes boiling of acidified analytical solutions before oxidation with Br_2 and $KMnO_4$: acetoacetic acid is destroyed; citric acid remains unchanged. Thus all previous determinations (except the method of Pucher and Sherman) on citric acid require reinvestigation.

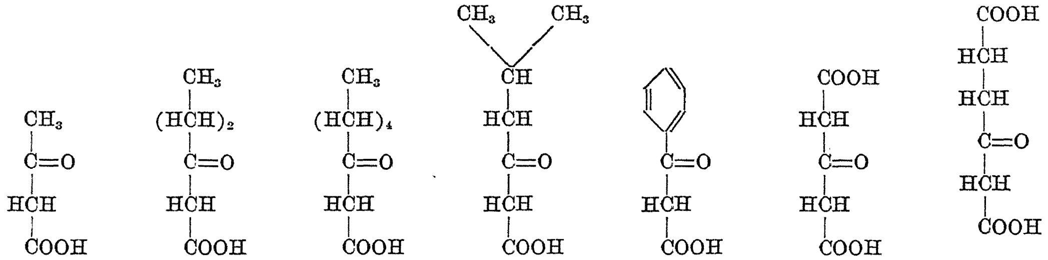
On the contrary, the cycle is the main course in breakdown of fatty acids. Thirty-eight years ago Knoop[10] discovered β-oxidation. Though much work has been done, the subsequent course of breakdown of β-keto acids could not be detected. I have discovered a new enzyme (citrogenase), catalyzing the following reaction:



n-β-keto acid + oxalacetic acid → n-2 acid + citric acid

The n-2 acid, so produced, is again β-oxidized; the citric acid is broken down over the cycle (discovered in all main reactions by Knoop and Martius[11] and Szent-Györgyi[12]) to oxalacetic acid and two mol. carbondioxide. Citrogenase is only specific with β-keto-acids, but not specific with R. It has been shown[3] that the following β-keto-acids give the same condensation-reaction.

Not only β-keto-mono carbon acids give the break-



down condensation, but also β-keto-dicarbon acids, thus showing that also β-keto-dicarbon acids after ω-oxidation of Verkade are condensed in the same way. The enzyme occurs in large amounts in muscle, kidney, brain, but little in liver and not at all in spleen, pancreas, lung, thus confirming perfusion experiments of Snapper and Grünbaum, showing that muscle, kidney and brain metabolize large quantities of β-oxybutyric acid, liver only to a small extent and spleen and lung not at all.

The enzyme is extractable from tissue with 0.5 per cent. $NaHCO_3$; the solution is stable for some hours. It is destroyed by boiling, is sensitive to arsenic acid, to selenic acid, partly sensitive to NaF and not at all

[4] H. A. Krebs and others, *Biochem. Jour.*, 34: 442, 462, 775, 1234, 1383, 1940.

[5] H. A. Krebs, *Biochem. Jour.*, 36: IX, 1942.

[6] Thomas, *Enzymologia*, 7: 231, 1939.

[7] Stare, Lipton and Goldinger, *Jour. Biol. Chem.*, 141: 981, 1941.

[8] Evans and Slotin, *Jour. Biol. Chem.*, 136: 301, 1940; 141: 439, 1941.

[9] Wood, Werkmann, Hemingway and Nier, *Jour. Biol. Chem.*, 139: 483, 1941.

[10] Knoop, *Hoffmeister's Beiträge*, 6: 150, 1905.

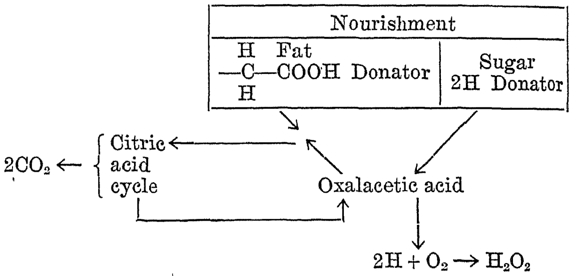
[11] Knoop and Martius, *Zeitschr. für physiol. Chemie*, 242: 1, 1935; 246: 1, 1935.

[12] Szent-Györgyi and others, *Zeitschr. für physiol. Chemie.*, 236: 1, 1935; 244: 105, 1936.

to iodacetic acid. The quantity of citric acid formed is about I–6 mg per gram wet tissue per hour at 38° C.

Oxalacetic acid is therefore the meeting point in sugar and fat metabolism. Sugar (as 2 H donator) and fat (as $-\overset{H}{\underset{H}{C}}-COOH$ donator) are in competition to metabolize oxaloacetic acid. Sugar-H is metabolized preferentially, as already small traces of sugar hydrogen reduce immediately and quantitatively small amounts of oxalacetic acid to 1-malic acid, while the condensation of β-keto acids with oxalacetic acid needs a surplus of oxalacetic acid, but only small amounts of β-keto acid.

Fat is only metabolized by oxalacetic acid, if small amounts of sugar are available; if no sugar at all is available, no pyruvic acid as precursor of oxalacetic acid (perhaps formed from pyruvic acid and carbon-dioxid after Evans and Slotin) is formed. Under such conditions β-keto acids are not metabolizable and we find the normal excretion of ketoacids in urine, as happens if much fat and little sugar are given with the food. We can formulate as follows:



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A MAP OF THE NATURAL AMINO ACIDS

Chart 1 has been designed as a visual aid for those whose work or interest is concerned with the protein-building α-amino acids. One may distinguish in each amino acid the $^{+}H_3N-\overset{|}{C}H-COO^{-}$ grouping which, as the carrier of the peptide-forming and acid-base functions common to all, may be termed the "body," and the remainder of the molecule, which, because it imparts to each compound its individuality and modifies the function of the "body," can be conceived of as the "head." Crude as this distinction is—as, for instance, it takes no account of the acid or basic functions of the dicarboxylic and diamino acid—it is useful as a basis for the systematic arrangement shown. In the chart each amino acid (to the extent permitted by current knowledge) has been characterized by a few data which may be considered as of fundamental chemical and biological significance. The first column of figures in the upper left corner of each space gives, in downward order, approximate figures for the optical rotation, on a molar basis, [M], in acid, neutral (isoelectric) or basic solution. The next column gives data on the dissociation constants of the acid and basic groups, expressed in pK values of acid ($-COOH$, $-OH$, $-SH$, $=NH_2^+$, $-NH_3^+$) groups. In those cases where groups other than carboxyl and amino are involved their identity is indicated by a symbol wherever possible. A figure separated by a blank space at the lower end of the pK column refers to the isoelectric point (pI). A figure in the upper right-hand corner shows the solubility at room temperature, in moles per liter. The figure to the left of the name is the molecular weight. A line under the name signifies that the amino acid is one of those found nutritionally indispensable (in rat and dog) for normal growth by Rose.[1] The dashed line (arginine) indicates that this amino acid can be synthesized by the animal organism but that the rate of bio-synthesis in the rat is not adequate for the requirements of normal growth. A dotted line under the name classifies the amino acid as one of those found necessary in the diet for the maintenance metabolism of adult rats.[2]

Those familiar with the chemistry of amino acids need not be reminded that of necessity the selection of the amino acids included in the chart is to some extent an arbitrary one, and that the same holds true for the numerical data given, where the dependence of optical rotations or dissociation constants on temperature or concentration, and other variables had to be ignored in favor of approximation values. The handbook of Schmidt[3] has been the source of most of the data shown. Blank spaces in the chart suggest possible undiscovered protein components. They do, however, neither exhaust the possibilities, nor has each space a hypothetical occupant. Spaces which for obvious reasons have no structural meaning have been marked by a black dot.

The chart is presented[4] in the hope that it may be of some use to the student, investigator and practitioner in fields ranging from physical chemistry to practical nutrition.

G. Toennies

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[1] Science, 86: 298, 1937.
[2] Burroughs, Burroughs and Mitchell, *Jour. Nutrition,* 19: 363, 1940.
[3] "The Chemistry of the Amino Acids and Proteins," Springfield, 1938.
[4] A limited number of reprints is available. A magnifying glass will aid in reading the small print.

LENGTH OF C HEAD				0	I	II	III	IV
NATURAL AMINO ACIDS	NEUTRAL	ALIPHATIC	STRAIGHT	75 GLYCINE	89 ALANINE		117 NORVALINE	131 NORLEUCINE
			SYMMETRIC	●	●	●	117 VALINE	131 LEUCINE
			ASYMMETRIC	●	●	●	●	131 ISOLEUCINE
			HYDROXY	●	105 SERINE	119 THREONINE	133 HYDROXYVALINE	
			THIOL	●	121 CYSTEINE	135 HOMOCYSTEINE		
			DISULFIDE	●	240 CYSTINE			
			THIOETHER	●	254 DJENKOLIC ACID	149 METHIONINE		
		CYCLIC	PHENYL AND INDOLYL	●	165 PHENYLALANINE		204 TRYPTOPHANE	
			PYRROLIDYL	●	●	●	115 PROLINE	
			HYDROXY	35 DIBROMOTYROSINE 34 DIIODOTYROSINE 34 DIHYDROXYPHENYLALANINE	181 TYROSINE		131 HYDROXYPROLINE	
	ACID	ALIPHATIC	STRAIGHT	●		133 ASPARTIC ACID	147 GLUTAMIC ACID	
			HYDROXY	●	●		163 HYDROXY GLUTAMIC ACID	
	BASIC	ALIPHATIC	STRAIGHT	●		120 CANALINE	132 ORNITHINE	146 LYSINE
			GUANIDO AND HYDROXY	●		176 CANAVANINE	174 ARGININE	162 HYDROXYLYSINE
			UREO	●			175 CITRULLINE	
		CYCLIC	IMIDAZOLYL	●	●		155 HISTIDINE	
			THIOL	●	●		187 THIOHISTIDINE	

SCIENTIFIC APPARATUS AND LABORATORY METHODS

IMPROVEMENT OF DEW-POINT DETERMINATION

IN the visual determination of a dew-point temperature, a polished metal surface is viewed under conditions favoring sensitive detection of a slight condensation of water upon the metal. The change in apparent reflectance of the cooled surface caused by the condensation is most readily observed in a hygrometer of the Alluard type, in which the cooled metal is closely bordered by polished metal which is not cooled. However, the zone between the two surfaces can be seen, and it is well known that the minimum detectable brightness differential in a photometrical field depends critically upon the width of the zone between the portions of the field. Moreover, temperature differences in the cooled metal plate are such that condensation usually starts in a central spot, and the advantage of a closely neighboring comparison surface is therefore not of much significance.

An excellent photometrical field can be produced easily on a polished surface through the use of a wetting agent.. A thin film of the wetting agent may be applied on an outer zone, leaving, for example, a rectangular central region untouched by the agent. All the film excepting an invisible layer is removed by rubbing with a clean cloth; the removal of the excess is done carefully, with strokes parallel to the edges of the plate, so that the two zones are sharply defined. Condensation of water upon the zone treated with the wetting agent immediately forms a continuous film and can not be seen, while the condensation upon the central zone occurs in the usual manner. Because of the exceedingly narrow line of demarcation between the two zones, it is believed that a reflectance differential of the order of 1.5 per cent. can be observed by an experienced operator. We have found that determinations of dew-point temperatures carried out with the technique described above are very appreciably more accurate (and more satisfying) than those previously made by the ordinary method.

From time to time it will be found desirable to clean and polish the whole metal surface, and apply a new film of wetting agent. Undoubtedly there are many agents which would function satisfactorily. The first one we tried (Victor Wetting Agent No. 35-B) left nothing to be desired.

J. A. VAN DEN AKKER
WILLMER A. WINK
THE INSTITUTE OF PAPER CHEMISTRY,
APPLETON, WIS.

QUIETING PARAMECIUM FOR CLASS STUDY

THE method described below for quieting *Paramecium* obviates most of the difficulties experienced with the usual techniques of anesthesia or mechanical constraint. It has been used with uniform success for two years in our elementary zoology course, and also at Coe College.

Three grams of compressed yeast, 30 mg congo red and 10 cc distilled water are mixed thoroughly and boiled gently for ten minutes. (This amount is ample for 200 students.) A thin ring of vaseline, 15 mm in diameter, is made on a slide with a syringe, and into this is put a drop from a very rich infusion of paramecia. This drop is then stirred with a teasing needle which has been dipped one-half inch into the stained yeast, and a cover is added and pressed down sufficiently to permit observation with the 4 mm objective. The color of the drop should be pink, not red, as too thick a suspension hinders observation. The medium keeps satisfactorily for at least a week if stoppered and refrigerated, and should be shaken before use.

Feeding begins at once, and in five minutes nearly all animals have several vacuoles of diverse sizes packed with bright red yeast cells. At first the animals swim rapidly, but in less than ten minutes many individuals settle down. They tend to aggregate at the surfaces of air bubbles, clumps of yeast or masses of zooglea (which last may profitably be added), often lining up like pigs at a trough. The student can then see in different animals all stages of feeding, including the ciliary beat and currents in the gullet, the filling of the vacuole, its elongation and pinching off, its course through the cytoplasm and the eventual defecation of the apparently indigestible yeast. Moreover, since congo red is a hydrogen ion indicator, it gives evidence of chemical changes occurring in the food vacuoles: In most animals the majority of vacuoles are bright orange-red (pH 5.0 or above), but usually these are interspersed with brilliant blue vacuoles (pH 3.0 or below) and with some of intermediate purple. The indigestibility of the yeast is a possible cause of another instructive phenomenon, for it can often be seen, after a time, that some of the paramecia are rejecting all but an occasional yeast cell, and forming vacuoles packed with bacteria.

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UNIVERSITY OF ROCHESTER

BOOKS RECEIVED

BELL, CLIFFORD and TRACY Y. THOMAS. *Essentials of Plant and Spherical Trigonometry*. Illustrated. Pp. vi + 142. Henry Holt and Company. $1.80.

BENNETT, H. *Practical Emulsions*. Pp. x + 462. Chemical Publishing Company. $5.00.

FISHER, RONALD A. and FRANK YATES. *Statistical Tables for Biological Agricultural Medical Research*. Illustrated. Pp. viii + 98. Oliver and Boyd, Ltd. 13/6 net.

SCIENCE NEWS

Science Service, Washington, D. C.

A NEW SUNSPOT CYCLE

THE sun has entered on a new 11½-year sunspot cycle, during which the freckles on his face will become more and more numerous for half that period, and then wane to a minimum in 1954 or 1955. The first group of spots identified as belonging to the new cycle have been photographed at the Naval Observatory by Mrs. L. T. Day. It was observed and its magnetic polarity noted by Edison Hoge at Mt. Wilson Observatory, Calif.

The first indication that the new spot group is the first of a new sunspot cycle was given by their position, well away from the sun's equator. The last spot group of the old cycle, close to the equator, was visible at the same time. Then an instrumental check-up showed that their magnetic polarity is opposite to that of spots in the cycle just closing. This reversal of polarity is a "sure sign" of the opening of a new cycle.

Sunspot abundance has been shown to have a direct relation to radio reception. When they are most numerous, the sun is giving off intenser streams of atomic particles, which affect the height of the world's "radio roof," the Kennelly-Heaviside layer, and hence the range of radio signals. Their possible effects upon terrestrial weather of solar radiation connected with sunspots is still a much-debated point.

Several notable particulars were pointed out in the wire from Mt. Wilson Observatory which notified Science Service of the first observations made at that place: "The first sunspot group definitely belonging to the new cycle was observed by Edison Hoge on May 16 at 9 A.M., PWT, at the 150-foot tower telescope of Mt. Wilson Observatory.

"The spot group extended from heliographic latitude south 40 degrees to 44 degrees, and had magnetic polarities opposite to spots of the old cycle in the southern hemisphere. It thus satisfies the two fundamental characteristics of spots of the oncoming cycle: that it be in a latitude much greater than the average latitude for sunspots (15 degrees), and that it have a magnetic polarity opposite those of spots of the old cycle in the same hemisphere.

"This is the first time since 1889 that the first spot of the new cycle has been so far south of the equator. The first spot of the present old cycle was seen on October 10, 1933, in latitude 26 degrees north.

"The spot appeared near the edge of the sun's disk that is being carried from view by the solar rotation. When last observed on May 17, it was increasing in area. The spot will vanish on May 19 and if it survives the journey on the side of the sun turned away from the earth should reappear on June 3."

THE PRODUCTION OF PENICILLIN

THAT the production of penicillin, the chemical from mold, which outdoes the sulfa drugs in curing many kinds of wound infections and germ diseases, is now being pushed to the utmost to make it available for our armed forces, is reported by Dr. A. N. Richards, chairman of the Committee on Medical Research of the Office of Scientific Research and Development, in the *Journal* of the American Medical Association.

The use of penicillin to treat soldiers returned from the Pacific area with unhealed compound fractures, osteomyelitis and wounds with longstanding infection was started six weeks ago. Results of this treatment started at Bushnell General Hospital, Brigham City, Utah, have been so encouraging that plans are now being made to continue studies of its value in treating both wounds and venereal disease in sixteen Army hospitals. The Navy plans similar though less extensive clinical trials of penicillin.

Production of penicillin, in spite of intense efforts to meet military medical needs, has in no instance gone beyond the pilot plant stage. In most plants it is still in the laboratory stage. Some sixteen drug manufacturing companies are now engaged in its production or intend to be soon. The supply for civilian needs in the near future will be very limited, he states, unless production expands at a greater rate than can now be foreseen.

The chief handicap to large scale production lies in the fact that the mold produces only very limited amounts of the germ-fighting chemical. An exceptionally high yield would be in the order of about one thirtieth of an ounce by weight from about twenty quarts of culture medium on which the mold that produces penicillin is grown. And it takes days of mold growth for production of this minute amount.

Discovered by Dr. A. Fleming, of St. Mary's Hospital, London, in 1929, the curative possibilities of penicillin were first announced in 1940 and 1941 by Professor H. W. Florey, Dr. E. Chain and collaborators of the University of Oxford. Following a visit to this country by Professor Florey, and with the encouragement of the Medical Research Committee and the National Research Council, research looking toward the production of penicillin was started in the fall of 1941 by Merck and Company, E. R. Squibb and Sons, Charles A. Pfizer and Company, the Lederle Laboratories and perhaps others.

More than 300 patients have been or are being treated with penicillin and Dr. Richards states that "there is good reason for the belief that it is far superior" to any of the sulfa drugs for staphylococcus aureus infections with and without blood poisoning, including acute and chronic osteomyelitis, cellulitis, carbuncles of the lip and face, pneumonia, empyema and infected wounds. Penicillin is also extremely effective in treating hemolytic streptococcus infections, pneumomoccus pneumonia and gonorrhea.

TOOTH DECAY

TOOTHACHE may become a rare occurrence when an ideal diet is eaten throughout childhood. This hope is raised by three years of experiments reported to the American Dental Association by Dr. Julian D. Boyd, of Iowa City.

After observing children at the State University of Iowa for 17 years and making an intensive study of more than 200 children during the project just completed in

collaboration with the late Dr. Charles L. Drain, Dr. Boyd says: "Surely, the dietary approach offers the most effective means of attack on the problem of caries now available, and furthermore is one which is in step with current policies for the furtherance of public health. With prevalent improvement of children's diets, the seriousness of dental caries as a public health problem will decline to minor proportions."

Evidence that sugar content of the diet is probably of secondary importance will be presented in a forthcoming report. The diet of each child included in the studies was designed to be as near the nutritional ideal as possible. A strict regimen was possible because all the children were under medical supervision because of diabetes.

Possibility that the disease itself had influenced the rate of decay was eliminated; the amount of fluorine in the water, considered a factor in preventing decay, was also taken into consideration. It was concluded that diet alone influenced the rate of decay.

Public Health Service statistics indicate that the children in the area studied might expect to develop decay in two new tooth surfaces each year during the early teens, but the children observed by Dr. Boyd averaged only a fifth as much decay as expected on this basis.

FLOODS

NO major industrial damage is to be expected from the floods in the Midwest, for they are not occurring in industrial areas. Our floods are doing damage to agriculture, and to some extent to rail and highway transportation—which is bad, to be sure, but not to be compared with what hit the Ruhr valley industries when the bomb-loosed wall of water roared down on them a few nights ago.

To inflict comparable flood damage to an industrial area in the United States, the waters around Pittsburgh would have to go on a rampage. The Pittsburgh region is the one great steel-making and heavy-industry area in this country liable to river-borne disaster. High water has been on the Monongahela and Allegheny and upper Ohio rivers in the past, and can be expected again—but not this year. Flood time in those valleys is late winter or early spring. By mid-May, flood-making weather conditions have shifted well to the west; now is the time for floods on the lower feeders of the Ohio, and in the slow, flat rivers of the prairie and plains regions west of the Mississippi.

Spring floods are to be expected as a more or less regular thing, according to meteorologists of the U. S. Weather Bureau. As winter draws to a close, warm, moisture-laden air moves up from the Gulf region, meeting the retreating cold air of winter on a long front extending in a general northwest-to-southeast direction. At about this time of year, the front stretches from the lower Great Plains to the middle Great Lakes.

Normally, a series of late spring storms may pour rain on the Midwest for several days, bringing flash floods to the smaller rivers and perhaps swelling the larger ones to highwater mark. But as a rule these storms pass over before really bad floods occur.

This time, we unfortunately got what happens once a generation or so: An unusually rain-rich atmospheric situation developed, and then stagnated, with the heavens weeping over the same stretch of country for just about a solid fortnight. And so the floods came.

ITEMS

SUCCESS in the first trials of a new method of treating goiter by medicines instead of by surgical operation are reported by Dr. E. B. Astwood, of Harvard Medical School, in the *Journal* of the American Medical Association. The medicines used are thiourea and thiouracil. They have the unique property of inhibiting the function of the thyroid gland, actually, it is believed, preventing production of its powerful hormone. Patients with the kind of goiter in which popping eyes, extreme nervousness and thinness are symptoms suffer from too much thyroid hormone. This excess hormone drives the life processes at too fast a pace and even acts as a poison in its effects on the heart. Operation to remove part of the gland and thus reduce the amount of hormone produced has so far been the chief method of treating the condition. The results reported by Dr. Astwood suggest that patients in future may not need to have this operation but can have their too-active thyroid glands kept under control by taking daily doses of thiourea or thiouracil.

COD liver oil and other fish oils may prove to be a source of a high blood pressure remedy, was reported by Dr. Arthur Grollman and Dr. T. R. Harrison, of the Bowman Gray School of Medicine at Wake Forest College, to the New York meeting of the Society for Experimental Biology and Medicine. Fish body and liver oils, they discovered, contain a substance which is effective in reducing high blood pressure in rats. The substance is not the same as vitamin A, which is contained in fish liver oils and which some have believed has a blood-pressure reducing effect. It is, however, similar to the kidney extract hailed a few years ago as a potential remedy for high blood pressure. Both the kidney extract and the fish oil substance can be given by mouth. Both reduce the blood pressure slowly and have a relatively prolonged effect compared with other substances that reduce high blood pressure. The blood-pressure reducing substance, however, is present in only small amounts in animal kidneys. Fish oils, on the other hand, are relatively potent in reducing blood pressures and are readily available. Therefore, in the opinion of the investigators, they "offer greater promise than kidneys" as a source of a blood pressure remedy.

A NEW aid to protect the hearing of workers in noisy industries, such as shipbuilding, and which promises to be "the solution for certain industrial ear problems" is reported by Dr. David A. McCoy, of Boston, in the forthcoming issue of the *Journal* of the American Medical Association. It consists of an ear mold of transparent plastic lucite, made to fit each worker's ear. This custom-made feature provides a good fit with no leaks of noise and one which is comfortable to wear all day. The ear mold reduces the intense and high-frequency noises, which are distracting, painful and deafening, but lets the wearer hear people talking without trouble. A further advantage of this plastic ear mold is that it shuts out the flying balls of hot slag which are a danger to the ears of welders and chippers.

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AIR-BORNE INFECTION[1]

By Professor O. H. ROBERTSON, M.D.

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AN increasing awareness on the part of the medical profession of the rôle played by the air in the transmission of respiratory disease makes it seem appropriate just now to survey briefly the recent rapid growth of knowledge in this field. While it has been long known that bacteria can be carried on air currents, the general belief has grown up that certain physical agents such as sunlight, heat and drying are very effective in destroying such air-borne microorganisms. However, during the past few years our knowledge of the wide distribution of bacteria in the air has been greatly increased. Apparently the whole of our atmosphere is contaminated since microorganisms have been recovered from the stratosphere and from freshly fallen snow in the south polar regions. Some of the most striking evidence of aerial transmission of infection comes from the investigation of the spread of certain plant diseases. Epidemics of wheat-stem rust have been shown to be wind-borne from infected areas far distant. Spores of this infection have been found to be carried as much as 1,000 miles in 48 hours and cause an outbreak of the disease a week or ten days later. Similarly, plant viruses have been shown to be disseminated to some extent by wind, at least in an indirect manner, through the agency of leaf-hoppers and plant-lice.

While we have no evidence that any specific agent of human disease is spread through the outside air, except in the case of insect vectors, there is a growing body of data in support of the conclusion that air transmission within enclosed spaces plays an important rôle in the communication of many bacterial and

[1] An address given before the Rochester Academy of Medicine, N. Y., October 6, 1942.

virus diseases, especially those of the respiratory tract. Before proceeding to a consideration of such evidence, I believe it would be of interest in view of our present military state, to review briefly the incidence of respiratory disease in the last war. Of the total number of 108,000 deaths in our armed forces during the period of April 1, 1917, to November, 1918, 50,000 were caused by battle casualties and 58,000 by disease —the usual higher rates of disease to battle casualty deaths, but a much smaller proportion than in previous wars. However, in contrast to other wars, respiratory disease accounted for 47,000 of the 58,000 or 80 per cent. of deaths due to disease in general. This high percentage of deaths from infection of the respiratory tract was of course due to the pandemic of influenza—the fatalities being caused principally by pneumonia. Of particular interest is the fact that probably the majority of the fatal pneumonias were associated with hemolytic streptococcus infection. An increase in the prevalence of the hemolytic streptococcus began with the measles epidemic in the army in the winter of 1917–1918 and when influenza arrived in 1918 the streptococcus was widespread.

The health of our armed forces during the first ten months of this war has been excellent. Respiratory disease, though mild, has however been very prevalent and has accounted for approximately half the total of all cases admitted to hospital for disease in general. While there have been very few deaths from respiratory tract infections, the amount of time lost from duty has been considerable. Surveys of hemolytic streptococcus carriers have revealed a much lower percentage than was present at a similar time during World War I, but among the soldiers suffering from acute infection of the respiratory tract these microorganisms are commonly found. Hence the hemolytic streptococcus presents a menace should the present type of respiratory disease become more severe or should an epidemic of influenza occur. Other pathogenic microorganisms, the pneumococcus, Pfeiffer's bacillus, hemolytic staphylococci, would, of course, play a rôle under such circumstances, but probably a less conspicuous one.

EVIDENCE FOR AERIAL TRANSMISSION OF INFECTION

While the actual proof of infection occurring through air transmission is difficult to obtain except under experimental conditions either with animals or human volunteers, indirect evidence from clinical observation and bacteriological study is accumulating rapidly. Such instances of the spread of measles and chickenpox have been reported under conditions where direct and indirect contact has in all probability been excluded. Furthermore, the direction of the spread has frequently been shown to be that of the flow of the air currents. Wheeler and Duckett Jones[2] have recently reported an outbreak of highly fatal hemolytic streptococcal infection in a rheumatic fever hospital in which the infection spread from the lowest floor to the upper floors immediately above by way of the stairways where an upward air current was demonstrated. While no tests for air-borne bacteria were made at the time of the initial epidemic this was done later and the infecting types of hemolytic streptococci were recovered from the air of the stairways. An instance reported by White,[3] of what would appear to be aerial infection with dust-borne hemolytic streptococcus, was that of a ward attendant who having had no previous contact with this type of infection swept out a room which had been closed for five days following the discharge of a patient who suffered from streptococcal infection. Shortly thereafter the attendant developed an acute throat infection of the same type of hemolytic streptococcus as that producing disease in the patient.

An understanding of the manner in which air-borne infection can occur has been furthered greatly by the concept of droplet nuclei introduced by William Wells,[4] namely, that many small droplets expelled from the respiratory tract evaporate so rapidly that they float in the air for prolonged periods of time and ultimately settle in the dust of the room. Observations by a number of workers, English and Canadian in particular, have corroborated this idea of the manner of air contamination and have shown the importance of the rôle of dust and particulate matter from bed clothes, etc., in distributing pathogenic microorganisms through the air. A detailed account of some of these observations would be of interest, but time doesn't permit of more than a brief mention of some of the most striking findings. (Buchbinder[5] has given an excellent summary of this data in his recent review of the transmission of certain infections of respiratory origin.) Cruickshank[6] was the first to show that the rapid increase in the incidence of streptococcal infection of burns after coming into the hospital was due to cross infection from one or more cases carrying or infected with this microorganism. Furthermore, he was able to recover from the air of the ward considerable numbers of hemolytic streptococci of the same type as those causing the cross infections. Similar studies have been made by Allison and Brown[7] in scarlet fever wards where they found

[2] S. M. Wheeler and T. Duckett Jones, *Aerobiology*, Am. Assn. Advancement of Science Symposium, 17: 237, 1942. Also personal communication.
[3] E. White, *Lancet*, 1: 941, 1936.
[4] W. F. Wells, *Am. Jour. Hygiene*, 20: 611, 1934.
[5] L. Buchbinder, *Jour. Am. Med. Assn.*, 118: 718, 1942.
[6] R. Cruickshank, *Jour. Path. and Bact.*, 41: 367, 1935.
[7] V. D. Allison and W. A. Brown, *Jour. Hygiene*, 37: 11, 1937.

that complications and relapses in scarlet fever patients were due to reinfection with a type of hemolytic streptococcus other than that causing the primary infection. These reinfecting types were recovered from the air of the ward. Allison[8] has also made observations on the spread of streptococcic infection in a measles ward. The cross infections, due to the introduction into the ward of patients carrying the infecting types, occurred in individuals heretofore free from streptococci. Similar observations in diphtheria wards have revealed the presence of virulent diphtheria bacilli in the floor-dust and air at times when cross infections with these microorganisms were occurring.[9] A study by Miles[10] and associates of war wounds infected with streptococcus hemolyticus showed that they were cross infections from types of streptococci present in the air and the dust of the ward. Hare and Willits[11,12] have demonstrated the rôle played by dressings of streptococcal wounds and bed clothes of such patients in the aerial dispersal of hemolytic streptococci. Handling the dressings, especially dry ones, resulted in liberating considerable numbers of these microorganisms, which the authors were able to recover from the air by means of blood agar settling plates. Their finding that bed making of infected patients causes a marked increase in air contamination provides adequate reason for the advisability of isolating such cases.

Experimental studies on air-borne infection with certain pathogenic bacteria has yielded more conclusive evidence for this mode of transmission. Trillat[13,14] showed many years ago that experimental infection of small animals with paratyphoid or fowl cholera bacilli could be accomplished by exposing them to atmospheres containing a finely atomized mist of cultures of these microorganisms. Wells and Lurie[15] found that pulmonary tuberculosis in rabbits could be produced by placing these animals in a chamber into which cultures of tubercle bacilli had been sprayed. Studies on air-borne pneumococci, on the other hand, have yielded little evidence that pneumonia in normal animals is acquired simply by inhalation of pneumococcus-containing droplets. However, if the animals' resistance is lowered by alcoholization, as shown by Stillman and Branch,[16] or if it is suffering from experimental influenzal infection as first demonstrated by Smorodintseff and co-workers,[17] inhalation of pneumococcus-containing atmospheres will result in pneumococcal infection of the lungs.

Another disease whose dispersal has been suspected to occur by way of the air, but in which evidence of aerial transmission has been lacking until recently, is influenza. Repeated attempts made in 1918 to transmit to human volunteers the pandemic influenza, failed. It was not until 1937 that a group of Russian workers headed by Smorodintseff[18] succeeded in producing influenza in human volunteers by allowing them to inhale influenza virus dispersed in fine droplets in the air. Since then aerial transmission of influenza in ferrets has been accomplished.[19,20] More recently, Smorodintseff,[17] Wells and Henle[21] and our laboratory[22] have been able to produce experimental influenza in mice by the air-borne route. The virus employed, having been passed through several hundred mice following its isolation from a human case, was atomized as a very fine mist into a chamber containing the mice to be infected. We found that an exposure of only 15 seconds to an amount of virus diluted 300,000 times in the chamber air sufficed to produce pneumonic lesions in all the mice. A two-minute exposure resulted in death of all the animals. Even with amounts of virus corresponding to a dilution in the air of one to thirty million, all the mice acquired pulmonary lesions. That influenza virus may remain suspended in air in a viable and infective state for relatively long periods of time was demonstrated by introducing mice into virus-containing atmospheres as long as three hours subsequent to atomization of the virus. All the mice became infected.

It seems likely that the virus of the common cold may also be communicated through the air, but of this we have no proof. Neither do we have any information as to the mode of transmission of the newly recognized acute pulmonary disease which has been designated as primary atypical pneumonia. However, one disease, whose communicability through the air had not been heretofore seriously considered, namely, poliomyelitis has recently been transmitted experimentally by the air-borne route.[23]

Control of Air-borne Infection

Measures available and which are now being advocated for the control of air-borne infection fall into

[8] V. D. Allison, *Lancet*, 1: 1067, 1938.
[9] W. E. Cristie and H. D. Wright, *Lancet*, 1: 656, 1941.
[10] A. A. Miles *et al.*, *Brit. Med. Jour.*, II: 855, 895, 1940.
[11] R. Hare and R. E. Willits, *Canad. Med. Assn. Jour.*, 44: 230, 1941.
[12] R. E. Willits and R. Hare, *Ibid.*, 45: 479, 1942.
[13] A. Trillat and R. Kaneko, *Comp. Rend. Acad. de Sci.*, 173: 109, 1921.
[14] A. Trillat, *Ibid.*, 194: 321, 1932.
[15] W. F. Wells and M. B. Lurie, *Am. Jour. Hygiene*, Sect. B, 34: 21, 1941.
[16] E. G. Stillman and A. Branch, *Jour. Exp. Med.*, 40: 733, 1924.
[17] A. A. Smorodintseff *et al.*, *Arkhiv. biologicheskekh Nauk*, V. 52, No. 1, 1938.
[18] A. A. Smorodintseff *et al.*, *Am. Jour. Med. Sci.*, 194: 159, 1937.
[19] A. Trillat, *Comp. Rend. Acad. de Sci.*, 205: 1186, 1937.
[20] C. H. Andrews and R. E. Glover, *Brit. Jour. Exp. Path.*, 22: 91, 1941.
[21] W. F. Wells and W. Henle, *Proc. Soc. Exp. Biol. and Med.*, 48: 298, 1941.
[22] C. G. Loosli, O. H. Robertson and T. T. Puck, *Jour. Inf. Dis.* In press.
[23] H. K. Faber and R. S. Silverberg, Science, 94: 567, 1941.

two categories—those designed to prevent dispersal of infectious material into the air and those employed or proposed for reducing the infectivity of already contaminated atmospheres, by killing or removing the disease-producing agents.

It has been shown that pathogenic microorganisms—such as the hemolytic streptococcus and pneumococcus—may remain suspended in the air for many hours or days and that their virulence after several weeks' sojourn in the dried state in dust is unimpaired. Buchbinder's[24] observations are especially informative in this respect. Since air currents redistribute the bacteria which have settled in the dust, control of dust has become an important consideration in preventing air contamination. Experiments of Van den Ende[25] and Thomas[26] have demonstrated that the bacterial content of the air of wards or patients' rooms may be greatly reduced by oiling the floors and sweeping with oiled or moistened brooms. Furthermore, they and others have found that treating blankets with a diluted light mineral oil is most effective in preventing distribution of bacteria from the bed clothes. Employing both these measures resulted in a reduction of more than 90 per cent. of air-borne bacteria.

The most important preventive measure is the isolation of the infected patient. This is most effective when single-room isolation is employed. Ward isolation, *e.g.*, segregation of patients suffering from the same communicable disease, is of course much less costly and under certain conditions the only feasible measure, but the grouping of patients with such diseases as measles, scarlet fever or influenza presents the hazard of cross infection of various kinds. For example, scarlet fever patients hospitalized in separate rooms rarely acquire types of hemolytic streptococcus other than that producing the infection, whereas those placed in wards commonly become reinfected with new types and show a much higher incidence of complications. Barriers between the beds and adequate spacing of patients undoubtedly diminish the direct transfer of infected droplets from patient to patient but appear to have little effect in preventing the distribution of dried or dust-borne bacteria.

Another measure for preventing dispersal of bacteria and viruses into the air is adequate masking. I use the word "adequate" advisedly since most of the masks employed in hospitals are relatively ineffective. Jennison's[27] stroboscopic photographs have afforded striking demonstration of air contamination by sneezing and coughing especially by persons suffering from colds, and the effect of proper masking of such individuals. The Canton flannel mask devised by McKhann[28] has been found to be a highly effective and practical one. The relative impermeability of this type of mask even under the great pressure of a sneeze provides good evidence for its effectiveness in preventing the inspiration of infective droplets.

While the institution of such measures provide, a good ground-work for the control of air-borne infection and may under certain favorable conditions be adequate, there still remains the need for reducing the infectivity of contaminated atmospheres. This applies especially to conditions in times of war, under which isolation of infectious patients may be difficult or impossible, and other procedures of preventing air contamination, including continuous masking of ward personnel, becomes impractical. It seems likely that air-borne infection of both bacteria and virus origin depends on the concentration of the infectious agent in the atmosphere. Wells's studies have brought out this point and our own results on experimental transmission of influenza to mice, as well as the observations of others, lend support to this conclusion. If the concentration of the pathogenic material in the air can be kept below a certain critical level, infection only seldom occurs, *i.e.*, the dosage of inhaled pathogens is not sufficient to cause disease—although infection may occur if the dosage is increased by prolonged inhalation of even a small concentration of the infectious agent. Thus any measure which will sufficiently lower the concentration of an air-borne infectious agent should be effective in reducing or eliminating infection. The means which has been most commonly employed for this purpose is ventilation. If a sufficient number of air changes per hour can be secured, the building up of a high concentration of any infectious agent can be prevented. Reyniers[29] has made use of filtered outside air flowing through a system of complete mechanical barriers—consisting of a primary chamber containing the patient and a secondary one connecting with the corridor. While this installation is effective in protecting the patient completely against infection by attendants and bacteria-containing air in the corridor or ward, it is too complicated for use in the average hospital.

EFFECT OF ULTRAVIOLET RADIATION

The bactericidal effect of light has been shown by Buchbinder[5] to be surprisingly effective. Sunlight most of all, but diffused daylight from a blue sky killed 50 per cent. of streptococci and pneumococci

[24] L. Buchbinder, M. Solowey and M. Solotororsky, *Jour. Bact.*, 42: 615, 1941.

[25] M. Van den Ende, D. Lush and D. G. Edwards, *Lancet*, II: 133, 1940.

[26] J. C. Thomas and M. Van den Ende, *Brit. Med. Jour.*, I: 953, 1941.

[27] M. W. Jennison, "Aerobiology," Am. Asn. Adv. Sci. Symposium, 17: 106, 1942.

[28] W. McKhann, data to be published.

[29] J. A. Reyniers, "Aerobiology," Am. Asn. Adv. Sci. Symposium, 17: 254, 1942.

in three quarters of an hour. Hence large window space is most desirable for hospitals. The most potent light effect is that from the ultraviolet end of the spectrum, and the use of specially constructed lamps for the purpose of air-sterilization has now been the subject of study for a number of years. The development of this field has been due principally to Wells[30] and while the number of well-controlled observations on the value of ultraviolet radiation in the control of the spread of air-borne infection is as yet limited, evidence is being accumulated to show that under certain conditions and in certain types of disease ultraviolet radiation is effective. I will mention briefly several studies which seem to demonstrate that the use of germicidal lamps has reduced strikingly the incidence and spread of air-borne infection. One was made by Hart[31] at the Duke University Hospital. For some reason, possibly due to the peculiar locality or the kind of upper respiratory tract flora of the operating room personnel, their incidence of post-operative infection was alarmingly high. Hart made a bacteriological study of the air of the operating rooms and the throats of the surgeons and nurses and found pathogenic bacteria, especially hemolytic staphylococci, very prevalent. He then had ultraviolet lamps installed above the operating tables so that the whole operative field was irradiated. Very promptly the occurrence of post-operative infection was greatly reduced and this was accompanied by a marked diminution in the number of bacteria in the air of the operating room.

A second study has been made at the Cradle in Evanston by Sauer, Minsk and Rosenstern.[32] One ward in this institution was equipped with ultraviolet lights arranged in such a way that each infant's cubicle is protected against the rest of the occupants of the ward by means of a so-called curtain of radiation, *i.e.*, the lamps are placed over the open entrance of the cubicle and throw a screen of light to the floor. During the winter of 1940–41, one of the infants in the control ward contracted a cold. This ward was simply air-conditioned. Within a month or six weeks, the respiratory infection spread throughout the entire ward, affecting every one of the 12 infants. However, in the radiated ward not a single cold occurred despite the fact that some of the nurses in the ward contracted colds during this period. A third ward with doubly partitioned chambers built on the principle of Reynier's mechanical barrier showed only one infection.

A striking instance of the control of chicken-pox with ultraviolet radiation has been reported by Barenberg and associates.[33] In an institution housing 165 infants and children, 97 per cent. developed chicken-pox while not one of the children in the irradiated ward contracted the disease. A recent study of Wells, Wells and Wilder,[34] provides evidence for the control of measles and mumps by means of germicidal lamps installed in schoolrooms. This study, which extended over a five-year period and included observations on a large number of children in three schools, showed that the incidence of measles, in particular, in the irradiated classrooms was very much lower than that occurring among the pupils in the non-irradiated rooms.

The limitations on the use of this form of air-sterilization are that the persons in the irradiated rooms must be shielded from the light which has the sun-burning effect of bright sunlight. This means that in situations other than the special one described in the Cradle installation, it is possible to irradiate only the air above the head. While under these circumstances bacteria and viruses in the upper air of the room can be killed, control of the contaminated lower air depends on air currents which will carry the infected droplets or dust particles up into the stratum of germicidal light. Under certain conditions such partial sterilization of the air may be adequate as pointed out earlier but in other cases more complete killing of air-borne infectious agents may be required. Furthermore, dust-borne bacteria are more resistant to the light than are bacteria carried in droplets. Ultraviolet light is now being employed in a number of different kinds of environments and data should be forthcoming as to its general effectiveness and limitations.

CHEMICAL AIR STERILIZATION

Another method of air-sterilization which has been recently introduced is that of disinfection of the air by chemical means. While the idea of employing bactericidal mists as a method for controlling air-borne infection dates from Lister's original use of phenol sprays in preventing wound infections in operating rooms, until recently no one had succeeded in producing by this method a sterile or relatively bacteria-free atmosphere which could be tolerated by human beings. During the past few years new means of chemical air-sterilization have been devised. These consist in the dispersal of germicidal mists containing the effective chemical agents in such small amounts as to be non-detectable or at least unobjectionable to persons in the treated atmosphere. The compounds

[30] W. F. Wells and M. W. Wells, *Jour. Am. Med. Asn.*, 107: 1698, 1936.

[31] D. Hart, *Jour. Thoracic Surg.*, 6: 45, 1936.

[32] L. W. Sauer, L. D. Minsk and L. Rosenstern, *Jour. Am. Med. Asn.*, 118: 1271, 1942.

[33] L. H. Barenberg, D. Green, L. Greenopan and B. Greenberg, "Aerobiology," Am. Asn. Adv. Sci. Symposium, 17: 223, 1942.

[34] W. F. Wells, M. W. Wells and T. S. Wilder, *Am. Jour. Hygiene*, 17: 254, 1941.

employed for this purpose are believed to be non-toxic in the minute amounts present in the inspired air.

The initial report on this new approach to the control of air contamination was made by Douglas, Hill and Smith in 1928.[35] They employed a fine spray of a solution of NaOCl and found that in concentrations of one gram of the solution in two million cc of air—complete killing of *B. coli* dispersed in the air could be effected. However, it was not until ten years later that active development of the subject began. In 1938 two papers appeared, one by Trillat[36] concerning the properties of germicidal aerosols—liquid aerosols consist of droplets 1–2 microns in diameter dispersed in air—and the other paper by Mastermann[37] on air-sterilization by atomizing NaOCl solutions. Trillat found that certain germicidal agents which killed bacteria in the test-tube in dilutions not higher than 1:200, were capable of causing death of air-borne bacteria when dispersed in aerosol form in concentrations of one gram of the chemical substance in 5 million cc of air. He believed that the bactericidal activity was due to direct interactions between aerosol droplets and bacterial particles. Mastermann, on the other hand, believed that the high bactericidal effect of NaOCl—he obtained killing effects on air-suspended bacteria in concentrations of one gram of NaOCl in 40 million cc of air—was due to the liberation of HOCl gas from the NaOCl mist and was not an aerosol effect. In the next two or three years, studies by several groups of English workers confirmed and extended Trillat's and Mastermann's observations. Twort and associates[38] employed an aerosol consisting of hexyl resorcinol dissolved in propylene glycol and reported bactericidal effects on certain non-pathogenic microorganisms with extraordinarily small amounts of this material—as little as one gram in four billion cc of air. Pulvertaft and Walker[39] used resorcinol in glycol as well as NaOCl and found both these effective in killing pathogens of the respiratory tract. Andrewes[40] found that influenza virus was susceptible to the lethal effect of these germicidal mists.

Our studies in this field consisted initially in the search for a substance which would fulfil most nearly the requirements for an ideal air-sterilizing agent, namely, that it be non-toxic, non-irritating to the respiratory tract, odorless, tasteless and yet possess a marked and rapid killing action on bacteria suspended in air. Furthermore, it should be relatively inexpensive and easily obtainable. Among the compounds tested which included a number of glycols, it was found that propylene glycol most nearly fulfilled these requirements.[41] This compound, a dihydric alcohol, is closely related to glycerine and has the formula $C_3H_6(OH)_2$.

Studies on the air-sterilizing activity of propylene glycol, which are still in the experimental stage, have shown that this substance, when dispersed as an aerosol or in vapor form, produced rapid killing of large numbers of air-borne bacteria. Pathogenic bacteria of the respiratory tract, pneumococci, hemolytic streptococci and staphylococci, *H. Influenzae* and *H. Pertussis,* were killed immediately when sprayed into atmospheres containing concentrations of one gram of propylene glycol in two to four million cubic centimeters of air. Lesser concentrations of the glycol exerted an immediate and pronounced bactericidal effect although a certain interval of time was required for complete sterilization of the air. Dried bacteria were also shown to be susceptible to the lethal action of the glycol. Adequate controls have been carried out to show that this is a bactericidal and not simply a bacteriostatic effect. Killing of the virus of influenza A was demonstrated by tests in which mice placed in an atmosphere of propylene glycol vapor were found to be protected completely against infection with amounts of air-borne influenza virus that produced death regularly in the control animals.[42]

Knowledge concerning the mechanism of the bactericidal effect of propylene glycol on air-suspended bacteria is still incomplete. However, it has been possible to acquire certain information which has provided the basis for a tentative explanation of the initial phase of this process. It was found that propylene glycol possesses a relatively low germicidal action *in vitro.* Certain bacteria such as the pneumococcus and staphylococcus grow well in broth containing 5 to 15 per cent. of the glycol, but if these microorganisms are suspended in 80 to 90 per cent. propylene glycol they are killed immediately. The means by which a mist of this glycol can produce a lethal concentration in the immediate environment of the bacteria would seem to be limited to two possibilities: (a) direct contact between the glycol droplets and bacterial particles; (b) the production of sufficient vapor or gas by evaporation of the glycol droplets to permit rapid and abundant collision of gas molecules with the bacterial particles. Calculations of the maximum number of contacts between aerosol and bacterial droplets indicate that it would take between 2 and 200 hours for sterilization to occur if this were the mode

35 S. R. Douglas, L. Hill and W. Smith, *Jour. Indust. Hygiene,* 10: 219, 1928.

36 A. Trillat, *Bull, de l'Acad. Med.,* 3 Sc. 119: 64, 1938.

37 A. T. Mastermann, *Jour. Indust. Hygiene and Toxicity,* 20: 278, 1938.

38 C. C. Twort, A. H. Baker, S. R. Finn and E. O. Purcell, *Jour. Hygiene,* 40: 253, 1940.

39 R. J. V. Pulvertaft and J. W. Walker, *Jour. Hygiene,* 39: 696, 1939.

40 C. H. Andrewes *et al., Lancet,* 2: 770, 1940.

41 O. H. Robertson, E. Bigg, T. T. Puck, B. F. Miller, *Jour. Exp. Med.,* 75: 593, 1942.

42 O. H. Robertson, C. G. Loosli, T. T. Puck, E. Bigg and B. F. Miller, SCIENCE, 94: 612, 1941.

of action. The exceedingly rapid bactericidal action which we have observed could be accounted for only if the glycol were present in the gas phase. Since propylene glycol is a highly hygroscopic substance rapid absorption of glycol gas by fluid droplets might be expected to occur. Indeed calculations show that with vapor concentrations even below the saturation values of propylene glycol the number of collisions between gas molecules and droplets containing bacteria is sufficient to produce almost instantly a lethal concentration (up to 80 per cent.) of propylene glycol in the droplets. Furthermore, the observed rate of evaporation of droplets of a propylene glycol mist is so rapid that a relatively high vapor concentration is liberated within a second or two. The problem as to how the glycol, once having achieved the effective concentration in the bacterial droplet, kills the microorganisms has not been elucidated.

Before practical application of this method of air-sterilization by germicidal mists and vapors can be instituted, the conditions under which they are most effective should be clearly understood and conclusive evidence of the harmlessness of breathing such chemically treated atmospheres must be secured. That the degree of relative humidity has a marked influence on germicidal action has been recognized by Baker and Twort[43] in the use of their aerosols and has also been found by us in the study of propylene glycol vapor. These air-sterilizing agents are most effective at relative humidities of 40 to 60 per cent. Our studies have shown that the amount of propylene glycol vapor which can be held in the air is inversely proportional to the relative humidity, thus increasing the humidity above the medium range results in a progressive diminution in the concentration of glycol vapor in the air and hence a diminished bactericidal effectiveness. On the other hand, the lessened activity of the glycol vapor in dry atmospheres, even though the vapor is present in relatively high concentrations, may be attributed to rapid desiccation of the bacterial droplets which diminishes their affinity for propylene glycol molecules. We found that temperature also affects this process. Increasing the temperature from 15° to 35° C results in a progressive decrease in bactericidal action.[44]

Other important problems which require elucidation are: (1) the most efficient means of dispersing the chemical agents into the air; (2) the manner in which they can be evenly distributed throughout an enclosed air space; (3) determination of the concentrations desirable and obtainable under varying conditions of ventilation; (4) tests for purity of different lots of propylene glycol or other agents. These problems are being studied.

The question of possible toxic effects from breathing atmospheres containing chemical compounds can be answered only by long-term observations on appropriate animals. There are considerable data in the literature on the toxicity of propylene glycol when administered orally or injected intravenously. Prolonged feeding experiments by a number of workers have shown that rats fed relatively large amounts of propylene glycol for periods of six months to two years apparently suffered no ill effects. Intravenous injection of this substance has shown that it is less toxic than ethyl alcohol. The low toxicity of propylene glycol is quite probably due to the fact that it is metabolized in the body.

We have exposed rats to this glycol in vapor form continuously for a period of 15 months. These animals have shown no ill effects from their sojourn in such an atmosphere and microscopic examination of the lungs and other organs of the body has revealed no changes not seen in similarly aging normal rats. While this is good presumptive evidence for the harmlessness of propylene glycol, we have felt that adequate information on this important point can be obtained only in an animal corresponding more closely to the human being in posture and lung structure. Both clinical and experimental observations indicate that foreign material is eliminated from the lungs of non-erect animals much more readily than it is from those species maintaining a more or less erect posture. Although propylene glycol is readily soluble in the body fluids and would probably be absorbed from the lung, it is possible that accumulation might occur in the lungs of man while an equivalent quantity would be adequately eliminated from the respiratory tract of the rat. Furthermore, we have found that small amounts, one fourth to one half cc of propylene glycol in liquid form, injected directly down the trachea of a rat, produces marked irritation leading to abscess formation and fibrosis. Hence, we have instituted a long-term test in exposing monkeys to propylene glycol atmospheres.

Thus far, little data are available on the practical use of germicidal mists and vapors. This means for controlling air-borne infection has been used to some extent in England, but almost nothing has been published on the results. A brief preliminary report by Harris and Stokes[45] on the effect of propylene glycol vapor in reducing acute respiratory infection in a children's ward suggests that it may be effective.

It would seem probable that the different measures

[43] A. H. Baker and C. C. Twort, *Jour. Hygiene*, 41: 117, 1941.

[44] Unpublished experiments.

[45] T. H. Harris and J. Stokes, Jr., *Am. Jour. Med. Sci.*, 204: 430, 1942.

employed or proposed for the control of air-borne infection, *e.g.,* isolation, masking, dust control, ventilation, ultraviolet radiation and chemical air sterilization, would all prove useful either alone or in combination depending on the particular conditions and the purposes for which they are employed. Extended observations under well-controlled conditions will be required to determine the relative effectiveness of these methods. A study of this nature is now being conducted in an army hospital by the Commission on Cross Infection in Hospitals[46] under the direction of the Surgeon General of the U. S. Army.

OBITUARY

LUDWIG KALLIR

LUDWIG KALLIR, retired chairman of the board of directors and chief engineer of the A.E.G. Union Electric and Manufacturing Company, Vienna, Austria, died on January 7, 1943, in a London, England, hospital. He was 68 years of age. Mr. Kallir had been prominently identified with power generation, transmission and distribution in Central Europe for more than forty years. He was a member of the committee of action of the International Electrical Commission and the chairman of the committee for standard specifications of the Austrian Institute of Electrical Engineers. He represented his country at many international conferences as an official delegate; as such he spent some time in this country during the 1936 World Power Conference. Best known among his many papers and articles in the technical press and in the transactions of engineering societies was his contribution on "Power Transmission" in the well-known European handbook on electrical power edited by Rziha and Seidener.

Born in Austria in 1874, he received his engineering education at the Vienna Institute of Technology and graduated in 1896 with highest honors, and stayed there for the following four years as an instructor in electrical engineering until he joined the Union Electric and Manufacturing Company, Vienna, which was later bought by the A E G Berlin and became as their Austrian branch the A.E.G. Union Electric and Manufacturing Company. In 1908 he was assigned the duties of head of the central station engineering department. Later he became a member of the board of directors, finally its chairman and chief engineer of the company. He retired in 1937 and kept on in Vienna in a consulting capacity until German influence began to overrule first the economic and then the political life of his native country; however, there was no place for an upright man of his kind after the annexation of Austria and he went to England in 1939, where the British Electrical and Allied Industries Research Association, London, gave him an opportunity to keep on in his lifelong devotion to electrical engineering.

The outstanding qualities of Mr. Kallir as an engineer were matched by a charming personality and a deeply humane attitude towards those serving under and with him. Among many other honors which he received was his election as a member of the committee of action of the International Electrical Commission, and his appointments as an honorary consultant to the Austrian Department of the Interior and to the Board of Examiners of the Vienna Institute of Technology. He was a member of the American Institute of Electrical Engineers, the Institution of Electrical Engineers (London), the Swiss Institute of Electrical Engineers, the International Conference on Large High Voltage Systems (Cigré) in Paris, the Austrian Illuminating Society and a former president of the Austrian Committee of the International Electrical Commission and of the Austrian Institute of Electrical Engineers.

ERIC T. B. GROSS

CORNELL UNIVERSITY

HARRY L. DEMBER

DR. HARRY L. DEMBER was born at Leimbach, Germany, on July 11, 1882. Educated at the Universities of Göttingen and Berlin, he was appointed privatdozent at the Technische Hochschule, Dresden, in 1909. In 1914 he was appointed associate professor under Hallwachs. During the same year he was selected by the United German Academies to head a research group for studies in atmospheric optics and atmospheric electricity on Teneriffe.

Upon the death of Professor Hallwachs in 1923 he became professor and dean of the mathematics and physics faculty. When Hitler came to power in 1933 Dr. Dember was retired and awarded a government pension but was told not to enter the physics laboratory. However, in the same year a call came from the government of Turkey to head the department of physics in the University of Istanbul, which he accepted.

In 1941 he decided to come to America, where a daughter and a son had been in residence for some years. After a very long and difficult trip of about 15,000 miles via New Delhi and Cape of Good Hope, he and Mrs. Dember arrived in New York in November, 1941. He came to Rutgers University on January

[46] Board for the Investigation and Control of Influenza and other Epidemic Diseases in the Army, Preventive Medicine Division, Office of the Surgeon General, United States Army.

29, 1942, on a lectureship in physics. Later he was appointed visiting professor of physics. He passed away very suddenly on March 22, 1943. He fitted into the American university life and procedure astonishingly well considering his training and experience in Europe. He was very well liked by his students and associates. He was just about to publish a paper on photoconductivity of crystals. Throughout a very active life he has published some fifty or sixty papers, mainly in photoelectricity, canal- and x-rays. He will be missed very much both in teaching and research.

GEORGE WINCHESTER

RUTGERS UNIVERSITY

MINNIE TAYLOR YORK

To her many friends the sudden death of Mrs. York came as a great shock. As junior pathologist in the U. S. Department of Agriculture from 1913 to 1923 and as librarian of the Cleveland Museum of Natural History from 1924 to 1934 she had had the admiration and respect of all with whom she worked. Never willing to compromise with what was less than best, she possessed a remarkable sense of fairness in all of life's relationships. In spite of her professional duties and later her club activities and home responsibilities, she always found time for those unrequired details of kindness which bespeak a noble character. Many readers of SCIENCE knew Mrs. York as capable scientist, as gracious hostess and as friend. All such extend their sympathy to her husband and her mother.

W. G. HUTCHINSON

UNIVERSITY OF PENNSYLVANIA

RECENT DEATHS

DR. HAMILTON PERKINS CADY, professor of chemistry and chairman of the department at the University of Kansas, died on May 26 at the age of sixty-eight years. He had been a member of the faculty for forty-four years.

HAZEL C. CAMERON, research associate in nutrition in the Agricultural Experiment Station of West Virginia University, died on May 6 at the age of fifty-three years.

SCIENTIFIC EVENTS

THE AMERICAN CHEMICAL SOCIETY AND THE WAR MANPOWER COMMISSION

AT a meeting in Detroit on April 11 of the Board of Directors of the American Chemical Society, it was moved, seconded and carried unanimously that the letter of April 1, 1943, from Secretary Charles S. Parsons to H. T. Briscoe, of the War Manpower Commission, be approved and the board instructed the secretary to do all in his power to put the policy into effect.

In the letter which is printed in *Chemical and Engineering News* Dr. Parsons emphasizes the fact that the society is, and always will be, ready to serve the War Manpower Commission in any way it can be useful. Its function in this effort, however, is confined to the proper assignment and utilization of chemists and chemical engineers. He continues:

Electrical, mechanical, civil, sanitary and radio engineers, physicists, mathematicians and other groups of specialists are needed in both the combat and production armies. Except in a few specific instances, already overstaffed, chemists and chemical engineers have no utility as such in the combat forces.

Clearly foreseeing the situation and probable emergency, the American Chemical Society through its officially constituted defense committee met with General Hershey in December of 1940 and carefully considered the problem that faced the country. The American Chemical Society's committee on national defense consists of Roger Adams, dean of chemistry at the University of Illinois, *Chairman;* James B. Conant, president of Harvard University; Warren K. Lewis, head of the department of chemical engineering at the Massachusetts Institute of Technology; Thomas Midgley, Jr., vice-president of the Ethyl Corporation and chairman of the board of directors of the American Chemical Society; Edward R. Weidlein, director of the Mellon Institute and (at that time) chairman of the Chemicals and Allied Products Division of the War Production Board; Robert E. Wilson, president of the Pan American Petroleum and Transport Company; and myself, secretary of the society.

At that and subsequent conferences a general plan of procedure was formulated in accord with the major premises already outlined and, through its publications, its national and sectional meetings and by thousands of letters and other direct communications, the American Chemical Society has done all in its power to enlighten the profession, the industry, the public and the local, appeal and state boards of the true situation and its importance to the war effort. In this campaign the society has been supported, seconded and assisted by General Hershey and his able staff. Local and appeal boards and state directors have been informed through occupational bulletins and other so-called directives that chemists and chemical engineers should be deferred where utilized in the war effort or in training others therefor. Unfortunately, Selective Service can only advise and has no authority to order. In spite of all efforts, as previously stated, approximately 5 per cent. of the chemists and chemical engineers of the country are in the Army or the Navy serving ably but not in a chemical capacity. However, it is no small accomplishment that approximately 95 per cent. of those subject to the draft are serving to-day in the Production Army. Retention of this high per-

centage is due in a large measure to the educational campaign conducted by the American Chemical Society with the active cooperation of the Selective Service System constituted by law for such purposes, as its name implies.

Having outlined the problem and recorded two and one-half years of experience, I can reply now to the questions you have propounded.

If your suggested committee is to handle and give advice regarding the classification of chemists and chemical engineers, essentially the same as the committee which has been formed to advise in cases of physicists (Local Board Release 159), the American Chemical Society is prepared to function. We can readily present to you suggestions for its make-up from among the best chemists and chemical engineers in America—men who will serve without compensation from the War Manpower Commission or from the Government.

However, if it is the War Manpower Commission's proposal to form a committee of heterogeneous "engineers" to function for all "engineers," including those specifically trained chemically, we prefer to continue to serve America and the country's qualified chemical engineers as we have been doing. We do not believe that a heterogeneous committee of electrical, mechanical, civil, radio, sanitary and other engineers can hope to envision the problems of the chemical industry or those of the chemical engineers themselves, as could a committee composed of members of the chemical profession; nor do we believe that the War Manpower Commission or Selective Service itself would have equal confidence in its findings.

THE COPERNICAN QUADRICENTENNIAL

AT the celebration in New York City on May 24 of the four hundredth anniversary of the death of Copernicus, messages were read from President Roosevelt and the President of Poland, Wladyslaw Raczkiewicz, now in London. Copernican citations were conferred upon a group of pioneers in science and civilization, nine of whom were Americans and one Chinese.

President Roosevelt's message was read by Professor Harlow Shapley. The President wrote:

> Not only must great men and great nations be allowed to attain freedom. Liberty must be made progressively available to small states, to communities, and to the individual himself if humanity is to march forward into light and life. We must always remember that the creation and sweep of great liberalizing ideas may be the work of a single isolated individual, as in the case of Copernicus.

Dr. James Rowland Angell, president-emeritus of Yale University, was chairman of the committee on citations. Those honored with citations were:

Dr. John Dewey, "who has stimulated and enriched the thinking of his time in education, philosophy and in all arts of life."

Walter (Walt) Disney, "whose animated cartoons have delighted audiences the world over."

Professor Albert Einstein, "whose revolutionary concept of space, time and energy has transformed both science and philosophy."

Henry Ford, "for opening a new horizon to manufacture."

Dr. Ernest O. Lawrence, of the University of California at Berkeley, "inventor and builder of the most powerful engine of transmutation of the elements."

Dr. Thomas Hunt Morgan, of the California Institute of Technology, "author of a revolution in our knowledge of the causes and mechanisms of inheritance."

Igore I. Sikorsky, "pioneer aeronautical engineer who has created a helicopter of revolutionary implications."

Dr. Wendell M. Stanley, of the Rockefeller Institute at Princeton, N. J., "discoverer of a crystalline protein having all the characteristics of disease-producing virus, a concept revolutionary for the study and control of virus disease."

Orville Wright, "who fashioned wings for man and showed him how to navigate the ocean of the air."

Dr. James Y. C. Yen, of Chungking, who invented "a simple, easily mastered system of written Chinese whereby the book of knowledge has been opened to millions of previously illiterate minds."

PRESENTATION OF THE FIRST CHARLES L. MAYER AWARD

PRESENTATION of the first Charles L. Mayer Award of $2,000 was made to Dr. Charles Huggins at the annual dinner meeting of the Board of Directors of the National Science Fund of the National Academy of Sciences, which was given on May 19 at the University Club, New York City. Dr. William J. Robbins, chairman of the fund, presided at the dinner and, following the citation for the award made by Dr. Peyton Rous, Dr. Frank B. Jewett, president of the National Academy of Sciences and a director of the fund, presented the award to Dr. Huggins. The citation reads:

> The work for which Dr. Huggins is to receive the first Charles L. Mayer Award makes possible the alleviation of cancer of the human prostate in a large proportion of instances, with perhaps a permanent control in some cases. But its implications are more than practical; they stress a principle which has been little regarded. In searching for means to combat cancer most workers strive to exploit the difference of tumor cells from normal ones, and sometimes with success, as in the treatment of cancers of the skin by Roentgen rays, the tumor cells succumbing to exposures which healthy elements survive. Dr. Huggins has proceeded in the diametrically opposite way; he has played upon what is normal in the malignant cells, the remaining good in them as one might say, and they have responded. This response is a fact which reveals. Hence, with your permission, I will speak briefly concerning it. And with apologies to Dr. Huggins, for there are few occasions which put a scientist more justifiably on tenterhooks than when another attempts in his presence to point to the place in nature of his discoveries.

Research workers found out a long while ago that they could induce cancers to appear in animals by irritating the tissues with various physical or chemical agents. The agents which do this, the carcinogens, call forth benign growths as well, tumors doing no harm other than that which may result from their bulk. And they not only bring cancers into being which are capable of slaying the host but others which need aid if they are to progress and which, in the lack of it—as when the carcinogen is discontinued—dwindle and vanish. The occurrence of such hesitant cancers, forced upon the organism under the exaggerated conditions of experiment, was first noted in 1915; but almost no attention has been paid to them for the reason that in human beings one seldom sees them, or rather, seldom perceives them for what they are. The growths which drive people to seek medical attention have already been tried out by circumstances, they are the fit which have emerged, they are going concerns. Yet if pathologists had only searched they might long ago have seen that the prostates of many men over forty contain tentative cancers, which come to nothing as statistics show, being still microscopic nodules in old age. It is the exceptional prostatic cancer which extends beyond the capsule of the organ. All this is very recent knowledge.

The gross differences in the behavior of human cancers, including the prostatic, are of course merely the expression of difference in cell capability and form. Cancer cells are popularly supposed to be in a state of anarchy, but this is seldom the actual case. Nearly always they are more like delinquents which make attempts in their poor way to carry out the accustomed tasks of entities of their sort. Some of those arising from glands deviate so little from the normal as still to produce secretions in line of duty, and often they build glandular structures as they proliferate, though crazy structures to be sure. More important in the present relation, they respond in greater or less degree to the influences affecting normal cells. Only in extreme instances do they wholly disregard the laws of organism. Most tumor cells appear to do the best they can with their disturbed abilities, differentiating and functioning so far as their abnormal state will let them and the urge that is on them to multiply.

It was upon these facts that Dr. Huggins acted. He was aware, partly through his own researches, that the activities of normal prostatic cells are maintained by the male sex hormones, substances elaborated in the testicles. What he attempted was to learn whether any prostatic cancers are still sufficiently like normal gland tissues to undergo involution with the latter when the stimulation by hormones is withdrawn. Putting aside the assertions of the text-books that castration had no useful effects in such respect he removed the testes of patients with hopeless prostatic cancers, after obtaining their consent. Dramatic happiness followed of which he will tell you.[1] They throw a far light.

That Dr. Huggins should be a surgeon is one of the happy circumstances of his achievement. Surgeons of all men have most direct access to tumors—I do not mean to play on words—yet it is their sardonic fate to have to employ their energies mostly in taking growths out, not in reasoning why as concerns them. Dr. Huggins, like the great surgeons of the past, has proved stronger than the demands of his vocations, and most rewardingly has he reasoned.

There is no natural phenomenon which challenges scientists in a more peremptory way than cancer. To layman and scientist alike it will seem fitting that the first prize administered by the National Science Fund, the Charles L. Mayer Award, should have been offered for "a contribution to our knowledge of factors affecting the growth of animal cells, with particular reference to human cancer." I am privileged in presenting Dr. Huggins for this prize. For his is more than a contribution to knowledge; it is an immediate gift to the welfare of man.

SCIENTIFIC NOTES AND NEWS

A TESTIMONIAL dinner to Dr. Walter S. Landis, vice-president of the American Cyanamid Company, was given on the evening of May 15 at the twenty-first annual meeting of the American Institute of Chemists. The gold medal of the institute was presented to him in recognition of his contributions to the field of chemistry. Speakers at the dinner were: Dr. Gustav Egloff, president of the institute and research director of the Universal Oil Products Company; Harry L. Derby, president of the American Cyanamid Company; and Maximilian Toch, president of Toch Brothers, Inc. Dr. Landis gave an address entitled "The Personal Service of the Chemist to the Nation."

DR. GUSTAV EGLOFF was the recipient of the Columbia University Medal of Merit for 1943, which is awarded annually to "an outstanding scientific or technological leader in industry." The medal was presented on June 1 at the convocation of the university.

L. M. PIDGEON, of the National Research Council of Canada, has been awarded the platinum medal of the International Nickel Company by the Canadian Institute of Mining and Metallurgy and the special merit medal of the Professional Institute of the Civil Service of Canada for his development of a successful method of producing metallic magnesium.

THE annual award of the President and Visitors Research Prize of the Virginia chapter of the Society of Sigma Xi this year was made at the twentieth annual meeting on May 25 to Dr. Gordon T. Whyburn for his work in the field of topology. At this meeting there were initiated two alumni, two faculty members, ten members from the Graduate Department and nineteen associates from the college, graduate and professional schools of the University of Virginia.

THE Ohio State University at its commencement exercises on June 11 will confer the doctorate of laws

[1] This address will be published in SCIENCE.

on Dr. Henry H. Goddard, professor emeritus of psychology of the university.

BOSTON UNIVERSITY on May 24 conferred the doctorate of science on Dr. Frank Howard Lahey, of Boston, founder of Lahey Clinic and chairman of the directing board of the Procurement and Assignment Service for Medical Personnel for the armed forces.

THE doctorate of laws of the Massachusetts State College at Amherst was conferred at commencement on Dr. Ralph R. Parker, director of the Rocky Mountain Laboratory of the U. S. Public Health Service. The doctorate of science was conferred on Leonard S. McLaine, Dominion entomologist of Canada.

DUKE UNIVERSITY on May 22, at its commencement exercises, conferred the honorary degree of doctor of science on Brigadier General James Stevens Simmons, director of the Preventive Medicine Division, Office of the Surgeon General, U. S. Army, and on Thomas A. Morgan, president of the Sperry Corporation.

THE honorary doctorate of engineering was conferred at the commencement exercises of Lehigh University on Dr. Per Keyser Frolich, director of the Esso Laboratories, Chemical Division, of the Standard Oil Development Company.

AT the commencement of Franklin and Marshall College the doctorate of science was conferred on Dr. James I. Hoffman, chemist of the National Bureau of Standards, and on Professor G. C. Chandlee, chairman of the department of chemistry of the Pennsylvania State College.

AT the annual meeting in New Orleans of the American Oil Chemists Society, Lamar Kishlar, St. Louis, research director for the Ralston Purina Company, was elected president for the coming year.

DR. EARL H. HERRICK, professor of zoology and mammalogist of the Agricultural Experiment Station at Kansas State College, has been awarded the Elizabeth Clay Howald scholarship of the Ohio State University. This scholarship carries a stipend of $3,000 for the year. It was established by the late Ferdinand G. Howald in memory of his mother. Dr. Herrick will devote his time to a study of vitamin E in relation to anterior pituitary function.

Nature states that officers of the Royal Astronomical Society for the ensuing year have been elected as follows: *President,* Dr. E. A. Milne, Rouse Ball professor of mathematics, University of Oxford; *Treasurer,* J. H. Reynolds; *Secretaries,* Dr. H. R. Hulme, chief assistant, Royal Observatory, Greenwich, and D. H. Sadler, superintendent of the "Nautical Almanac"; *Foreign Secretary,* Sir Arthur Eddington, Plumian professor of astronomy, Cambridge; *Council,* Miss M. G. Adam, chief assistant (astronomy), University Observatory, Oxford; Dr. E. C. Bullard, Smithson research fellow of the Royal Society; Dr. J. A. Carroll, professor of natural philosophy, University of Aberdeen; Dr. T. G. Cowling, lecturer in mathematics, University of Manchester; Dr. G. C. McVittie, reader in mathematics, University of London (King's College); Professor L. M. Milne-Thomson, professor of mathematics, Royal Naval College, Greenwich; F. J. Hargreaves, Dr. A. Hunter, Captain W. N. McClean, H. W. Newton, F. J. Sellers and W. M. Witchell.

ON the retirement of Sir Arthur Smith Woodward as president of the Paleontographical Society at the annual general meeting on April 21 he was elected an honorary member in recognition of his services to the society. Sir Arthur had been president of the society for nine years, following thirty years as secretary. During his period of secretaryship, in addition to the ordinary duties of that office, he contributed two important monographs on Cretaceous fishes to the series of volumes issued by the society, which describe and illustrate British fossils. He is succeeded as president by Professor H. L. Hawkins, professor of geology at the University of Reading.

DR. JOHN B. PARKER, for thirty years a member of the faculty of the Catholic University, Washington, has been made professor emeritus of biology.

DR. A. L. MELANDER, professor of biology and head of the department in the College of the City of New York, will retire at the close of the academic year.

DR. ROBERT G. CROSEN, associate professor of chemistry and acting dean of Lafayette College, has been appointed dean.

DR. HENRY NELSON HARKINS, since 1939 associate surgeon of the Henry Ford Hospital, Detroit, has been appointed associate professor of surgery at the Medical School of the Johns Hopkins University.

ENDING his twenty-fourth year as a member of the faculty of the Military College of South Carolina at Charleston and a teaching career of nearly half a century, Dr. Newland Farnsworth Smith, since September, 1919, head of the department of physics, will retire from active teaching at the close of the academic year. He has been given leave of absence until next September, when his resignation becomes effective. The corps of cadets paraded on May 21 in his honor and after the ceremony the commander of the regiment presented him with gifts from the cadet corps. Dr. Smith plans to take up work as a research physicist in the Philco Laboratories in Philadelphia, where his son, Newland F. Smith, Jr., has been for a number of years.

DR. W. HARRY FEINSTONE has been appointed director of biological research of the Pyridium Corporation of Yonkers, N. Y. He will be in charge of the Biological Laboratories and of development work on chemotherapeutic agents as well as on other pharmaceuticals.

THE *Journal* of the American Medical Association reports that Lieutenant Colonel Loyal Davis, professor of neurologic surgery at Northwestern University, is a member of an Anglo-American Commission to visit Russia. Since his arrival in London on September 6 of last year he has been senior consultant on neurosurgery in Europe. Another American member of the mission to Russia will be Colonel Elliott C. Cutler, of Peter Bent Brigham Hospital, Boston, and professor of surgery at Harvard Medical School. Colonel Cutler is senior consultant on general surgery to the American Expeditionary Force.

DR. GRANT L. DONNELLY, associate professor of pharmacology in the School of Medicine of the University of North Carolina, has resigned his professorship in order to resume practice in western North Carolina.

DR. BARRY G. KING has recently resigned as assistant professor of physiology at the College of Physicians and Surgeons, Columbia University. He has received a commission as lieutenant in the U. S. Naval Reserve as a physiologist assigned to medical research at the Naval Research Institute, National Naval Medical Center, Bethesda, Md.

DEAN C. J. MACKENZIE, acting president of the National Research Council of Canada, arrived in England on May 8. He planned to stay about a month and will make his headquarters with the National Research Council of Canada. Conferences will be arranged with scientific men in Great Britain on questions of scientific research connected with the war.

THE *Times,* London, states in its issue of May 6 that Professor S. A. Sarkisov, representing the executive committee of the Soviet Red Cross and Red Crescent Societies, had arrived in Great Britain to establish contact with the British Red Cross and British medical men, in order to develop mutual exchange of experience in the medical treatment of wounded and sick soldiers and in assistance to the civilian populations that have suffered as a result of the war.

PROFESSOR MARSTON T. BOGERT, of Columbia University, addressed on May 8 the annual meeting of the Columbia Chapter of Phi Lambda Upsilon. He spoke on "Malaria and Antimalarials."

THE American Society for X-Ray and Electron Diffraction will meet at the University of Michigan from June 7 to 11 under the presidency of Professor M. J. Buerger, of the Massachusetts Institute of Technology.

THE American Home Economics Association will hold a Wartime Institute at the University of Maryland with 225 delegates representing all state associations from June 18 to 21. This session has been planned in compliance with the request of the U. S. Office of Defense Transportation that all organizations "voluntarily establish travel conservation." Instead of the usual summer convention for several thousand home economists, this is to be a workshop type of meeting for a small number of persons each of whom is in a state position and in direct contact with large numbers of people. There will be a program of papers on "Strengthening the Home for War and Postwar Living." Each morning speakers from both government and non-government agencies and specialists in various fields will address the delegates; and each afternoon groups of fifteen or twenty will work together on problems of the family and on the ways in which home economists can help the family to solve those problems.

THE nineteenth Exposition of Chemical Industries will be held in New York City during the week of December 6 to 11 at Madison Square Garden instead of at the Grand Central Palace, the army having commandeered the exposition floors of the palace as an induction center. All exhibition space will be on one large floor. The actual amount of space available will be approximately half that of the 1941 exposition, which was held in the palace. A diagram of floor plans can be obtained from the International Exposition Company, 480 Lexington Avenue, New York City.

APPLICATION of arc welding to the design and construction of a jig for use in manufacture of electrical equipment, an arc welded chair and a radio tower were the respective subjects of papers for which engineering undergraduates of leading universities received the first, second and third awards in the Engineering Undergraduate Award and Scholarship Program of the James F. Lincoln Arc Welding Foundation. For a paper entitled, "Arc Welding versus Casting in the Design of Jigs and Fixtures," Herman J. Brenneke, of New York University, received the first award of $1,000 and four scholarships of $250 each were presented in his name to the department of mechanical engineering. "An Arc Welded Chair" was the subject of a paper for which Robert Edson Lee, of Iowa State College, received the second cash award of $500 and two scholarships of $250 each presented in his name to the department of architectural engineering. Application of arc welding to the design and construction of a radio tower was described in the paper for which Charles L. Sammons and John

H. Stewart, of the Ohio State University, jointly received the third cash award of $250 and a scholarship of like amount presented in their names to the department of civil engineering. In all seventy-seven awards amounting to $5,000 were made to students representing thirty-three colleges and universities.

DURING the year ended September 30, 1942, according to its annual report, the National Foundation for Infantile Paralysis received an income of $1,896,257, of which amount $1,827,345 represented net proceeds from celebrations of the President's birthday, the remaining $68,912 representing miscellaneous donations and refunds and cancellation of grants and appropriations authorized in prior years. In the same year the foundation made grants and appropriations amounting to $1,142,009, all of which, with the exception of $278,706, had been actually disbursed prior to November 30, 1942. Of the net proceeds of the 1942 Birthday Celebration, $2,099,617 was given for direct relief in communities throughout the United States.

DR. C. J. ELMORE, professor of biology at William Jewell College, Liberty, Mo., who died on May 19, 1940, bequeathed his diatom collection to the New York Botanical Garden.

THE University of Chicago has instituted the Lichtstern research assistantship in anthropology. It carries a stipend of $1,000 for nine months' work and will be filled each year in which a suitable candidate appears on nomination made by the chairman of the department of anthropology. The incumbent will devote most of his time during the year to performance of a piece of library, laboratory or field research, although he may also take one course or seminar each quarter. Applicants for the position will be asked to submit their research plans. The assistantship is supported by the Lichtstern Fund and commemorates Adolph Lichtstern, who established the fund by bequest.

FORMATION of a committee of Chicago chemists and other scientific men which hopes to uncover new sources of industrial fats and greases to salvage for war needs is announced by officials of the War Production Board, Chicago. Working with the War Production Board and the Chicago section of the American Chemical Society, the committee will promote improved and new methods of fat collecting among industries such as dairies, meat packing and margarine processing. The national goal for 1943 has been set at 500,000,000 pounds and chemists are being asked to help in the drive, which has its headquarters in Chicago.

DISCUSSION

THE MOBILIZATION OF SCIENCE

IT is to be sincerely hoped that every one concerned with the welfare of the future of science gives careful reading to the so-called "Mobilization of Science" bill presented to the Senate (S. 702) on February 11 by Senator Kilgore of West Virginia and reprinted in SCIENCE in the issue of May 7. The bill has been referred to the Committee on Military Affairs.

Every scientist professionally or otherwise engaged in scientific research, whether allied to public, private or industrial institutions or independently pursuing a field of scientific investigation, and every benefactor and patron of science must needs be affected by this bill.

The bill includes the establishment of an Office of Scientific and Technical Mobilization which shall be administered by an administrator to be appointed by the President of the United States and to serve at his pleasure, to authorize such administrator to formulate and promote scientific projects and programs, to assess scientific and technical developments with relation to the national welfare, to coordinate scientific facilities and personnel, to make and amend appropriate rules and regulations which shall have the force of law, to appropriate the sum of $200,000,000 to carry out the provisions of this proposed act and to provide maximum penalties of $5,000 and/or one year's imprisonment for certain infringements of the regulations that such an administrator may set up.

It is of course gratifying to learn in the declaration of policy of this bill that "the Congress hereby recognizes that the full development and application of the Nation's scientific and technical resources are necessary for the effective prosecution of the war and for peacetime progress and prosperity. . . ." It is less gratifying to note that "serious impediments thereto consist in the unassembled and uncoordinated state of information concerning existing scientific and technical resources; the lack of an adequate appraisal, and the unplanned and improvident training, development and use of scientific and technical personnel, resources, and facilities in relation to the national need; . . . the trend toward monopolized control of scientific and technical data and; . . . the absence of an effective federal organization to promote and coordinate . . . scientific and technical developments."

It is some two years since the organization of the National Defense Research Committee and the Office of Scientific Research and Development together with the National Roster of Scientific Personnel. The remarkable results to the war effort which have already been obtained thereby with the large expenditures of over $100,000,000 during the current year may well make one wonder as to the implications of the impedi-

ments cited. It is to be noted furthermore that the object of the bill is not solely to aid in the prosecution of the war but for "peacetime progress." If the passage of this bill were to insure not alone for the war but continuing thereafter the federal control of all science, scientists, scientific institutions and scientific funds, then perhaps a truer title for the document would be "a Bill for the Regimentation of Science." If so, then it would appear that this act if passed would effect the next to the last step in the breathtaking program of the complete socialization of our "democracy" under executive order. The last stage to take place would be the regimentation of religion were it possible to regiment the emotions.

This year celebrations are being carried on throughout the country in connection with the quadricentennial of the death of Copernicus and the publication of his epoch-making volume "De Revolutionibus Orbium Coelestium." Forgetting for the moment the three hundred years of controversy with organized religion which the promulgation of the heliocentric system of the universe engendered, one can not but wonder if Copernicus had lived in an era of government regulation of science such as is proposed whether his work would have fared better.

One has only to recall the history of science to recount a few of the outstanding scientific developments due to private enterprise and genius that undoubtedly would not have been possible under any enforced program of regimentation in science had such existed. Would any governmental administrator with a board of technical advisers politically appointed have ever sponsored the revolutionary experiments of Galileo, the doctrine of the origin of the species as advanced by Darwin or the germ theory of contagious disease and the technique of immunization developed by Pasteur? Would Morton and Warren, who with great difficulty introduced anesthesia against the prejudice of organized medicine, ever have been able to succeed in eliminating terror and pain from surgery if they also had been opposed by a board with federal authority? Would the two bicycle mechanics tinkering with gliders and flying machines ever have obtained a government subsidy for their Kitty Hawk experiments after the demonstrated failure of the Langley aeroplane which had been constructed under the Smithsonian Institution with a Congressional subsidy of $50,000? What board of experts politically appointed would have known how to evaluate these discoveries from out-of-the-way sources at the times when even colleagues and medical and scientific organizations looked askance upon the early stages of these developments?

When, in 1714, the British Government offered a prize of 20,000 pounds for a means of finding longitude at sea with an accuracy of one half of a degree, and James Harrison, a clever carpenter, in 1735 succeeded in solving the problem by the invention of the temperature compensated chronometer, would a regimented scientific body have been more speedy in the recognition of the ultimate recipient of the prize money than the British Admiralty who stalled over Harrison's invention because it was not the kind of a solution to the problem that occupied the categories of their thinking? When Federal authorities regarded the dreams of Samuel Morse as fantastic when he sought Congressional funds for the first telegraph line, would the inventor have made better progress under the investigation of such an advisory body than through his persuasive sincerity in gaining private capital?

The history of science would appear to point otherwise. Many American scientific inventions of utmost military value, notably the submarine, the airplane, aerial photography and gyro-direction finders had to be financed by other nations before federal appropriations gave our own country the advantage of the inventions.

Could the progress of science into new and unforeseen fields that has been made possible through the private capital and foresight of Carnegie and Rockefeller, neither of whom was tutored in the technicalities of science, have succeeded equally well under a government-controlled board having a like sum of money at its disposal? Fortunately or unfortunately genius is a strange plant in the economy of nature. One can not foresee the territories in which the germs of genius may sprout, nor can one produce the plant of genius by the mere application either of fertilizer or of the pruning knife. It is significant that many of the major discoveries of science have been made by individuals and not by organizations of science or scientists.

Very essential for the progress of scientific thought and development is freedom for the exercise of individual initiative. To have large funds at one's disposal for the furtherance of these ideas is, of course, to be highly desired, but what assurance exists that any politically created federal agency should have the uncanny perspective for evaluating initiative and enterprise except in terms of the categories then existing. Certainly the confusion that has arisen in Washington in our present-time "managed economy" and in the control of prices and man power is not sufficiently convincing to foster the belief that a federal administration of science would work more effectively.

The first attempt to institute a federal scientific advisory body for the benefit of national welfare was the creation of the National Academy of Sciences by President Lincoln in 1863 at the time of a national emergency.

At the beginning of World War I and at the request of President Wilson the National Research Council was established to act as an advisory body in scientific matters pertaining to the national emergency.

It is to be emphasized that in the executive order this Research Council was "to survey the larger possibilities of science, to formulate comprehensive projects of research and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects. To promote cooperation in research at home and abroad in order to secure concentration of effort, minimize duplication and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative as fundamentally important to the advancement of science."

With the inauguration of the New Deal administration under President Roosevelt a new kind of national emergency existed and a Science Advisory Board was called into being to implement the functions of the National Research Council and to advise the government relative to the administration of its scientific bureaus. It was noteworthy that most of the recommendations made by this advisory board as to specific questions raised by the government were acted upon favorably. However, additional recommendations initiated by this Science Advisory Board, though of far-reaching significance especially as concerning government bureaus of science, were not acted upon.

With the imminence of threatened hostilities the Science Advisory Board was rendered obsolete by the creation of a new organization, the National Defense Research Committee, for the complete organization and coordination of all scientific interests in the country in the interests of total war. This was done by executive order of President Roosevelt. This organization later became subordinated to a newly created Office of Scientific Research and Development directly responsible to the Chief Executive. What assurance is there that another newly created Office of Scientific and Technical Mobilization may be anticipated to be more successful than the collection of scientific advisory boards that they have supplanted.

It is certainly to be hoped that Senate Bill 702 will be given serious consideration by the scientists and scientific societies of the country not alone for its national but for its international implications. Unless those most concerned in maintaining conditions for the future progress of science give heed, it is not unthinkable that such a bill could be passed through the ignorance or lack of action on the part of those supposedly most intelligent in evaluating it. One may be tolerant of centralization of science during a war emergency, but when projected into a peacetime economy such centralized power may not only be inefficient but extravagant of public funds and may seriously jeopardize our international cooperation in science.

One is concerned in the preamble of this bill that so little recognition is given for the many well-known and effective scientific agencies that already foster and promote the welfare of science not only nationally but internationally, and that have deliberately made for the free exchange of ideas and the dissemination of information to the public. Every taxpayer should be made to understand the full implications of this bill before increasing the load of government expenditures by $200,000,000 plus for the beginning of an organization that in the end could well defeat the very purpose for which the mobilization of science act was proposed.

Unfortunately, apparently, it is not possible with present methods of bookkeeping to evaluate the cooperative scientific research of individuals, institutions and private capital which has been placed unstintingly at the disposal of the National Defense Research Committee in the interests of the war; but it is obvious that the total dollar value of salaried research men and laboratory equipment which has been freely placed at the government's disposal would render the $200,000,000 appropriation asked for in the Kilgore Bill, for the complete centralization of the science of the nation, wholly inadequate for the accomplishment of an equivalent effort.

The most significant new proposal of the Kilgore Bill not included in the executive order creating the National Research Council is "to make, amend, and rescind appropriate rules and regulations . . . which shall have the force and effect of law."

Moreover, it is to be observed that the proponents of this bill request Congress to pass a law that shall transfer their law-making power so far as it concerns the future of science to an unknown administrator without offering the benefit of knowledge of the kind of laws that such an administrator proposes to set up.

HARLAN T. STETSON

NEEDHAM, MASS.

THE OPPOSITION TO THE KILGORE BILL

THE two articles opposing the Kilgore Science Mobilization Bill which appear in SCIENCE for May 14, 1943, are certain to arouse widespread criticism. In particular, the article by the director of research of the Universal Oil Products Corporation, Dr. Gustav Egloff, who is also president of the American Institute of Chemists, contains statements so misleading as to require immediate correction. It is certainly not true that "over 95 per cent. of our scientific and technical manpower and facilities are now highly organized and coordinated to the single end of advancing the war effort." The statement that "practically every laboratory in the nation is in the service of the government"

is patently false. One has only to point to the thousands of biologists of all kinds, of geologists, mathematicians and other scientists whose work has no immediate relation to the war;[1] and to the many laboratories which are operating as usual without reference to either the war or the government. And is it true that "there are no secrets in the oil industry for the duration"?

Scientists should consider what the motives are which impel a representative of one of the great oil corporations to such gross exaggeration. Is it concern for the public good or for corporation profit? Dr. Egloff on other occasions has expressed his vigorous opposition to the Kilgore Bill in still less measured language[2] and it is evident that his fears are aroused by section 7—"Protection of the public interest in discoveries and developments financed by the United States"—which declares that property rights in discoveries made with public funds are to be vested in the public, and providing for just compensation to the discoverer. This seems to strike at the basis of private monopoly control based on exclusive private patent rights. If there are to be no secrets in the oil industry for the duration, it ought for the duration to withdraw its opposition to the legal recognition of such a lesser degree of pooling as is provided in the Kilgore Bill.

As for the opinion of the directors of the American Chemical Society that the bill would "confer totalitarian powers," one can only urge unbiased scientists to read the bill for themselves and to reach their own conclusions on this question.

L. C. DUNN

COLUMBIA UNIVERSITY

CLASS DISTINCTION AMONG AMERICAN MEN OF SCIENCE

IN a recent issue of SCIENCE, Professor S. O. Mast[1] objects to the designation of some one thousand "leading men of science" by a star in the forthcoming edition of the Biographical Directory of American Men of Science.

I object first to the manner of his objection, which seems more suited to a political squib than to a scientific periodical. He introduces the phrase "class distinction" with its logical denotation, but uses it to draw conclusions prejudiced by its political connotation.

I object secondly to the general principle which he puts forward in the name of "democracy," *viz.*, "There should be no fixed differentiation into classes in any group of individuals without the sanction of that group." I set up against this the principle of jurisprudence, "No one should be judged in his own case." I therefore suggest that Professor Mast's suggestion that "the continuation of 'starring' of scientists in the directory be put to a vote of those involved" should not be followed—unless among those "involved" be included all who use the directory or have an interest in its use as well as those whose names are included in it.

I maintain that democracy implies a vote of the whole people, and that Professor Mast's thesis leads to a negation of democracy, namely, syndicalism (against which *I* am prejudiced).

L. H. THOMAS

THE OHIO STATE UNIVERSITY

IS CORRECT LABELLING UNDEMOCRATIC?[1]

Mast, S. O., Ph.D. Johns Hopkins University, Baltimore, Md. Professor of Zoology. In Charge General Physiology, Johns Hopkins University. (1).

SUCH is the description to be found in the Federation Year Book, and to those searching for simple data, it is an admirably succinct label. That such statements quite clearly put The Doctor Professor Chairman Mast of Johns Hopkins University into a most exclusive class, not only amidst some half-million of his local fellow beings, but also in the entire world, is true. In spite of much levity, Ph.D.'s are not yet as common as blackberries and men capable of holding such positions as the above are very scarce. Moreover, to say there is but one Johns Hopkins is a statement of fact.

Consequently, the recent attempt of Dr. Mast to view a matter of simple grading through the curiously wrought lens of a political belief seems rather needless. Indeed, as seen through other glasses in common use in a nearby city, this attempt to remove useful data from a label might be considered false and misleading!

Technical labels have nothing to do with democracy nor any other political pattern, as I feel sure that Professor Mast experimentally rediscovers each time he corrects his examination papers. Nor would it seem really in the interest of science to decrease in any way our efforts quantitatively to estimate everything

[1] Nicholas, J. S., 1942, "The War Problem of Manpower in Biology and Agriculture," *American Scientists*, Vol. 30, pp. 297–298, estimates that in the biological sciences alone exclusive of medicine, there are available about 67,000 scientists. The National Roster of Scientific and Professional Personnel contains the names of thousands more not involved in war work.

[2] Egloff, Gustav, 1943, "Scientific, Technical, Inventive and Industrial Mobilization for War," address at the meeting of American Institute of Chemists, Washington, D. C., March 13, 1943. Scientists should also consult the evidence concerning Dr. Egloff's statements and opinions which were attacked by Judge Arnold and published in "Hearing on S 702 United States Senate," part 1, March 30, 1943, especially pages 9 and 17.

[1] S. O. Mast, SCIENCE, 97: 465, 1943.

[1] "Class Distinction among American Men of Science," SCIENCE, 97: 2525, May 21, 1943.

measurable, even our own abilities. That it should be snobbish to use such grading seems hardly tenable in an age when fruit, vegetables, pigs, meat, fish, flowers, drugs, chemicals and especially incomes are so treated. Why should distinguished professors or scientists expect to be excluded? It is not democratic!

O. S. GIBBS

MEMPHIS, TENN.

SCIENTIFIC BOOKS

RELATIVITY

An Introduction to the Theory of Relativity. By PETER GABRIEL BERGMANN. xvi + 287 pp. New York: Prentice-Hall, Inc., 1942. $4.50.

THE book aims to present the theory of relativity to students of physics and mathematics who have had no previous introduction to the subject. The material has been divided into three parts: the special theory of relativity, the general theory and a report on unified field theories.

We will confess that had we no previous knowledge of the theory of relativity we should find great difficulty in following the book. This results not so much from any fundamental difficulty in the subject itself as from the uncertainty concerning the degree of sophistication which one must adopt in interpreting the meaning of things at certain stages. Only by drawing upon his previous experience in this matter and by supplementing the material of the book by much interpretation and clarification drawn from his former thinking is the reader able to find the happy medium appropriate to the spirit of the book, and lying between the two extremes of a superficial attitude and a super-critical one.

Thus, on page 11, the reader may wonder what is intended to be meant by force in a statement which implies that the consistency of the ratio force to acceleration is a law of nature other than a definition. Referring to the introduction of relativistic electrodynamics in Chapter 7, one who has thought deeply on the subject would find it difficult to understand what is meant by the truth of Maxwell's field equations without supplementation by a force equation.

The foregoing illustrations are simply samples of many places in which one without additional background would find difficulty in fixing in his mind the matter of what is definition and what is experimental fact or assumed law of nature. However, such difficulties must inevitably arise in any book which attempts to cover a wide field in a relatively limited space, and the work will undoubtedly be found to be of considerable value to those who, having some acquaintance with the subject, desire a standard of reference; and it will be of great value to those who are able to read it under conditions in which there is at hand somebody who has thought deeply on the subject and is able to interpret to them such uncertainties as may arise.

The fact that the book has a foreword by the father of relativity, Albert Einstein, naturally enhances its value and dignity.

W. F. G. SWANN

BARTOL RESEARCH FOUNDATION OF THE FRANKLIN INSTITUTE

MICROBIOLOGY

Microbiology and Man. By JORGEN BIRKELAND. New York City: F. S. Crofts and Company. 478 pp. 35 figs. $4.00.

THE past ten or fifteen years have seen a remarkable development of popular interest in microbiology with a corresponding increase in the number of academic or non-technical students who take a course in bacteriology as a "cultural" subject. A large proportion of these choose this subject not so much from any curiosity concerning the nature of bacteria as from a curiosity, sometimes almost morbid, concerning disease. One can barely keep them awake when lecturing on the morphology and physiology and classification of bacteria, but can hold them spellbound when describing the symptoms of rabies. It is for such students that this book has been written.

The pragmatic approach to the subject is indicated by the title and by the first statement in the preface—"the proper study of mankind is man." To the reviewer it still seems that the proper study of the student of microbiology is the microbe, but he realizes that in this he is somewhat out of fashion.

In Dr. Birkeland's book emphasis is placed upon the effects of bacteria upon man, and while industrial or agricultural relations are mentioned here and there, mainly the book is concerned with bacteria in relation to human disease. An introductory portion of 130 pages considers the morphology and physiology of bacteria; the chapters on sterilization and disinfection are especially complete. A second section (50 pages) is concerned with general principles of infection and immunity, including epidemiology. A third section (184 pages) describes some of the more important infectious diseases and the organisms which cause them. Such details as age, racial and seasonal incidence; history; mode of spread and means of prevention, are gone into rather thoroughly. A fourth section (77 pages) deals with the microbiology of food, milk, water, sewage and soils, again with major emphasis on disease prevention. An appendix presents an outline of the classification of bacteria according to the latest edition of Bergey's Manual, a glossary of technical terms, and a list of references to various general and special works on microbiology.

So much space is devoted to descriptions of diseases and to what should properly be considered hygiene rather than bacteriology that much of the subject-matter of microbiology has been omitted or treated very scantily. Such important groups as the anaerobes, the spirochaetes, the Actinomycetes and the autotrophic bacteria are barely mentioned, but there is a discussion of the per capita cost of soap in relation to hardness of water! One may question whether it is desirable to devote so much of the time of a supposedly cultural course to public health, especially when so many students now take college courses in preventive medicine. Such a presentation gives the student a very one-sided picture of microbiology, as though its relation to disease were its sole *raison d'être.*

For such teachers as wish to place the emphasis where this book places it, Dr. Birkeland's text can be recommended. It is very readable, enlivened here and there by bits of verse and anecdote, with much history of disease and sanitation. The reviewer was particularly tickled by the recommendation that the student apply the principle of Koch's postulates to political problems. The style is clear and straightforward, the arrangement orderly. It should be a very easy book to study. The presentation is rather elementary, but in this respect the book is somewhat uneven. Thus the student is not expected to know anything about the structure of a cell, but is expected to know enough chemistry to follow the conversion of tryptophane to scatole and indole.

The teacher who uses this text-book will need to supplement it with a very complete laboratory manual, for it gives little of the technique of the bacteriologist. Particularly, there is not much discussion of the procedures by which species of bacteria are identified or distinguished. Here again the treatment is somewhat uneven. The student is told, for instance, how to distinguish caprine, porcine and bovine strains of *Brucella,* but not how to separate *Escherichia coli* from *Aerobacter aerogenes.* However, such deficiencies can be readily made up in an adequate laboratory course.

ARTHUR T. HENRICI

SOCIETIES AND MEETINGS

NORTH CAROLINA ACADEMY OF SCIENCE

THE forty-second meeting of the North Carolina Academy of Science was held at Duke University on April 30 and May 1. Approximately eighty papers were presented in addition to two symposia related to the war. The first symposium was on "Health and the War," the second on "Nutrition in War Time." The meeting was exceptionally well attended in spite of war restrictions and proved interesting and profitable to the membership. About forty-five new members were added to the roll, and a number of former members were reinstated after a lapse of several years of non-membership.

The following officers were elected: *President,* M. L. Braun, Catawba College; *Vice-President,* Mary E. Yarborough, Meredith College; *New Member of the Executive Committee,* E. H. Hall, of the Woman's College of the University of North Carolina. Bert Cunningham, of Duke University, continues as secretary. Section officers elected are:

Section	*Chairman*	*Secretary*
Botany	F. A. Wolf	E. C. Cocke
Geology	W. F. Prouty	Willard Berry
Physics	W. E. Speas	N. Rosen
Psychology	Elizabeth Duffy	K. Zener
Wild Life	John D. Findley	R. O. Stevens
Zoology	G. T. Hargitt	Eva G. Campbell
Biochemistry	H. W. Ferrill	J. C. Andrews

H. S. Perry was selected to receive the Poteat Award for his noteworthy paper on "Control of Starchy Contamination in Sweet Corn by the Use of the 'Gamete' Gene."

Two awards were made to high-school students—one to Robert Anderson for his essay entitled "Fire in the American Forests" and the other to Donald Hartzog for his exhibition in photography, which included portrait enlargements, stills and microphotographs.

The academy selected State College at Raleigh as the next meeting place.

From the standpoints of interest, attendance and worth of papers, this meeting is considered by many members to be one of the best the academy has had.

BERT CUNNINGHAM, *Secretary*

KENTUCKY ACADEMY OF SCIENCE

THE thirtieth annual meeting of the Kentucky Academy of Science was held at the University of Louisville, April 23 and 24, in five divisional meetings and two general sessions. Affiliated groups represented were Biology, Kentucky Branch, Society of American Bacteriologists and Kentucky Society of Natural History, in joint session; Chemistry; Geology; Psychology and Philosophy; Physics, Astronomy and Mathematics, in joint session. Forty-two papers were read including that of the president, Dr. J. T. Skinner, on "Some Functions of Mineral Elements in Connection with Enzymatic Action," before the

Academy in general session. At the annual dinner at the Seelbach Hotel, Herman F. Willkie, of Jos. E. Seagram and Sons, spoke on "Alcohol Goes to War."

In addition to their divisional meetings the Kentucky Geological Society and the Kentucky Society of Natural History conducted field trips in the Louisville area. The latter society became an affiliate of the Academy.

The grants for aid in research of the American Association for the Advancement of Science were awarded to W. R. Allen and to D. R. Lincicome, both of the University of Kentucky. Officers elected for 1943–1944 are as follows:

President, L. A. Brown, Transylvania College.

Vice-President, Paul J. Kolachov, Jos. E. Seagram and Sons.

Secretary, Alfred Brauer, University of Kentucky.

Treasurer, Wm. J. Moore, Eastern Kentucky State Teachers College.

Representative on Council of American Association for the Advancement of Science, Austin R. Middleton, University of Louisville.

Councilor to Junior Academy, Anna A. Schnieb, Eastern Kentucky State Teachers College.

ALFRED BRAUER
Secretary

SPECIAL ARTICLES

THE "VITAMIN M" FACTOR[1]

EARLIER studies by Langston and associates[2] have demonstrated that monkeys which were maintained on diet 600, a modification of the Goldberger diet 268, developed nutritional cytopenia. This deficient diet supplemented with either 2 g of liver extract or 10 g of dried brewer's yeast daily maintained nutritional balance in monkeys. However, the basic diet supplemented with nicotinic acid, riboflavin and thiamine failed to alter appreciably the course of the deficiency manifestations. The term "vitamin M" was proposed for this factor present in liver and yeast which prevents nutritional cytopenia in the monkey. The identification and chemical isolation of additional members of the vitamin B complex suggested to us a study of whether diets supplemented more fully by the other members of the complex would simulate the activity of vitamin M, in preventing nutritional disequilibrium.

Methods and materials. Healthy young adult *Macaca mulatta* were employed in these studies. Three diets were used (Table I). A basic diet free of members of the vitamin B complex was substituted for the 600 diet, since the vitamin content could thereby be more accurately and easily controlled. Diet 1 consisted of the basic diet supplemented with 5 members of the B complex; diet 2 contained 5 other members of the complex in addition to diet 1; and the control diet 3 was made up of the basic diet supplemented with 2 cc of crude liver extract. All the supplements were dissolved in water and administered by means of a stomach tube every other day, except the liver extract which was introduced subcutaneously every other day.

TABLE I

EXPERIMENTAL DIETS

Diet 1		*Diet 2*	
Basic diet	Per cent.	Diet 1 with addition of:	Daily ration mg
Sucrose	68	Choline chloride	50
Casein	18	Pimelic acid	1
Vegetable oil	8	Glutamine	1
Salt mixture U.S.P. number 2	4	Inositol	1
Cod liver oil U.S.P.	2	Sodium paraminobenzoate	50
Vitamin supplements:	Daily rations mg	*Diet 3*—Control	
Thiamine hydrochloride	1	Basic diet plus 2 cc of liver extract every other day.	
Riboflavin	1		
Pyridoxin hydrochloride	1		
Nicotinic acid amide	25		
Calcium pantothenate	3		
Ascorbic acid	25		

Results. All 6 of the monkeys on diet 1 and all 22 monkeys on diet 2 showed progressive weight loss, followed by lethargy, dryness of the coat and finally anorexia and weakness. Minor degrees of gingivitis appeared in about half the monkeys on both diets between the 21st and 44th diet days. As previously reported,[3] the animals on these dietary régimes developed leukopenia between the 4th and 15th weeks and displayed lowered resistance to experimental and spontaneous infections.[4] Significant degrees of anemia developed in less than half of the animals on diets 1 and 2.

Three monkeys each received limited supplements of a yeast residue containing folic acid.[5] They showed marked leucopoietic and clinical remissions during brief experimental periods.

Four monkeys on the control diet, supplemented with liver extract, exhibited none of the deficiency symptoms, in direct contrast to the other monkeys on the experimental diets, and gained weight and were in excellent health over a 6-month experimental period.

1 This work has been aided by a grant from the International Health Division of the Rockefeller Foundation. Constituents of the special diets were generously furnished by the S.M.A. Corporation.

2 W. C. Langston, W. J. Darby, C. F. Shukers and P. L. Day, *Jour. Exp. Med.*, 68: 923, 1938.

3 H. E. Wilson, C. A. Doan, S. Saslaw and J. L. Schwab, *Proc. Soc. Exp. Biol. and Med.*, 50: 341, 1942.

4 S. Saslaw, J. L. Schwab, O. C. Woolpert and H. E. Wilson, in press.

5 B. L. Hutchings, N. Bohoros, W. H. Peterson, *Jour. Biol. Chem.*, 141: 521, 1941.

Summary. The factor included in liver extract ("vitamin M") which is responsible for maintaining nutritional and hematopoietic equilibrium in monkeys is (1) apparently not identified with the following constituents as at present isolated: riboflavin, thiamin, nicotinic acid, pantothenic acid, glutamine, pimelic acid, choline, sodium paraminobenzoate, inositol and pyridoxin; or (2) if it is any of these factors, the combined administration of the above respective fractions did not result in the effect obtained with liver extract when given by the parenteral route (hypothetical "M" factor).

The administration of a yeast residue, containing, among other unknown elements, folic acid, more closely simulated the effect of parenteral liver extract than any other material we have thus far had the opportunity to test.

Liberal amounts of the basic diet and fresh water were kept in the cages at all times. The supplements were suspended in water and fed by stomach tube except liver extract which was administered subcutaneously. Diet and supplements were supplied by the S. M. A. Corporation.

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INOSITOL A TUMOR GROWTH INHIBITOR

THE importance of inositol for normal growth was established by the investigations of Eastcott,[1] Woolley[2] and others. There are no reports to date on the influence of inositol on malignant growth.

In this communication we describe the results of experiments dealing with the action of inositol on tumor growth. For these studies a rapid test for tumor growth inhibitors was employed.[3] In this test the inhibition of tumor growth is judged by comparing tumor sizes and tumor weights of treated groups of mice with untreated ones in an experimental period of 48 hours.

In Table 1 a series of experiments is presented, in which varying doses of inositol were studied. From this table it is evident that intravenous injections of inositol inhibit tumor growth, the degree of inhibition depending on the dose injected. Since September, 1942, inositol in varying doses was used in 16 experiments on 400 animals with the corresponding number of controls. The results of these experiments were similar to those presented in Table 1.

TABLE 1

EFFECT ON TUMOR GROWTH OF FOUR INTRAVENOUS INJECTIONS OF INOSITOL IN VARYING DOSES GIVEN OVER A PERIOD OF 48 HOURS*

Group No.	No. of animals in each group	Dose of Inositol γ	Mean terminal tumor weight mg	Standard error
453	11	0 (control: saline)	470	25.6
452	18	38	436	22.8
451	14	50	350	33.6
450	10	75	270	34.1
449	7	100	246	41.1
448	5	150	215	26.4
447	5	250	222	9.8
446	5	1000	142	12.8

*Female Rockland mice transplanted with Sarcoma 180; start of the experiment 8 days after transplantation; mice kept on polished rice diet for the experimental period of 48 hours.

Subcutaneous or oral administration of inositol was ineffective. Equally ineffective were intravenous injections of l-inositol,[4] inosose,[4] crystalline factors of the vitamin B-complex (thiamine, riboflavin, pyridoxine, nicotinamide, pantothenic acid, p-aminobenzoic acid, biotin and choline). Sodium phytate[4] and lipositol[4,5] showed an inhibition similar to that of inositol.

CONCLUSIONS

Inositol was found to inhibit tumor growth. The degree of inhibition depends on the dose injected. Inositol, a pure crystalline substance, can be used as a standard of reference for testing tumor growth inhibitory factors.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW OBJECTIVE METHOD FOR THE DETERMINATION OF THE CIRCULATION TIME

THE determination of the circulation time in animals and human beings has generally been associated with certain disadvantages. The various tests which require subjective cooperation on the part of the patient are open to many criticisms. Some of the disadvantages are evident in the case of children, deaf mutes, moronic or mentally sluggish individuals and

[1] E. V. Eastcott, *Jour. Phys. Chem.*, 32: 1096, 1928.
[2] D. W. Woolley, SCIENCE, 92: 384, 1940; *Jour. Biol. Chem.*, 139: 29, 1941.
[3] D. Laszlo and C. Leuchtenberger, Cancer Research, 1943. To be published.

[4] We are indebted to Dr. D. W. Woolley, of the Rockefeller Institute, New York, for generously supplying us with these substances.
[5] D. W. Woolley, *Jour. Biol. Chem.*, 147: 581, 1943.

those in stupor and coma. The intravenous injection of ether, saccharin or sodium dehydrocholate carry with them not only disadvantages but even dangers.

Occasionally, some subjects whose taste buds are not fully developed may not respond in the desired measure. For that reason, objective tests have been greatly sought. These have ranged from the use of sodium cyanide, histamine, 50 per cent. carbon dioxide, alpha-lobeline ether and, more recently, the use of fluorescein. These drugs are reported to produce objective results, but, as is the case with sodium cyanide, are often open to danger. Calcium gluconate can not be used in cardiac cases that have received digitalis therapy without serious complications.

The danger of complications following the intravenous injection of many of these substances is obviated by a new objective method we have devised. This method is based on the principle that light transmitted through various translucent tissues of the body, such as the ear, finger or toe tips, or flexible skin anywhere on the body (such as that over the calves of the legs, the arm pit or the skin web between the thumb and index finger), can be detected by means of a sensitive photoelectric cell.

The injection of certain non-toxic dyes, intravenously, such as 2 to 4 cc of a 1 per cent. solution of methylene blue, or 1.0 cc of phenol-sulphon-phthalein, acts as a temporary curtain to impede the transmission of light. Interference with the transmission of light by the dye can be observed by the deflection of the indicator of a sensitive galvanometer, connected with the photoelectric cell. The time elapsing between the injection of such a dye into the vein of the arm or leg and its arrival to the point where the light and photoelectric cell have been placed, can be determined by a stop-watch, or can even be recorded objectively, by connecting the leads from the photoelectric cell to a recording galvanometer.

Thus, an objective record determination of the circulation time is made possible, which no other method affords. The fluorescein method, the safest objective method to date, is open to the criticism that several individuals may not note it at the same time. The thickness of the skin or mucous membrane and its blood content may also modify the time of fluorescent visualization. The use of a dye with a light and photoelectric cell set-up, is not only of value in determining the circulation time, but also can be used for the determination of the time required for the blood to be cleared, as demonstrated by the return of the galvanometer needle to its pre-injection point. The determination of the circulation time is recognized today to be of value in differentiating thyrotoxicosis and cardiac decompensation from other conditions which may be confused with them.

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CONTRACTION OF DENERVATED MUSCLE PRODUCED BY d-TUBOCURARINE

FROM a consideration of the physico-chemical properties and especially the polarographic behavior of the alkaloid obtained from *Chondodendron Tomentosum* (d-Tubocurarine), and other quaternary ammonium bases having high reduction potentials, it seemed very probable that the rapid intra-arterial injection of this alkaloid would cause contraction of denervated muscles. This was shown to be true for dog-gastrocnemius denervated ten days previously. A strong contraction followed the close intra-arterial injection of d-Tubocurarine. The contraction was followed by partial relaxation and terminated by a long contracture which persisted for approximately thirty minutes. During the contracture and for a considerable time after the muscle was found to be unresponsive to previously effective quantities of intra-arterially injected acetylcholine. Direct stimulation of the muscle provoked contraction during the period of curarine-induced contracture. Full details of the experiments and a discussion of their significance will be published later.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE DISEASE PROBLEMS AFTER THE WAR

DISEASE and infection present gigantic problems to our armies fighting a global war, Professor K. F. Meyer, head of the department of bacteriology at the University of California, told the Western Section of the American Chemical Society. In wars, Professor Meyer pointed out, there has often been a much higher mortality rate from disease than from wounds. In the Crimean War, for example, there were 50 deaths from wounds to 192 from disease, while in the 1914–1918 World War the relation was 138 due to wounds and 115 from disease.

Not only is there the question of the health of the troops during the war, but of contacts among the home population when peace comes. When all these men come back, Professor Meyer said, we shall have carriers of all sorts of diseases. We must be prepared in civilian set-ups for possible eventualities. We remember that 1,000 people died of cholera in one month in Sacramento, Calif., during the '49 gold rush. The Army and Navy Medical Corps, working in conjunction with committees of the National Research Council, are developing every possible means of reducing the impact of these diseases to a minimum.

In the offices of the Division of Medical Intelligence there are on the walls maps of the world showing last minute data on the location of the various communicable diseases. Extensive outlines of the diseases likely to be met are prepared and given to medical officers before embarkation to the battle front.

In North Africa diphtheria appears in the form of skin ulcers which do not heal. In the caves of Tobruk there were sandflies and ticks that transmit fever. In Trinidad there are vampire bats. About 4 per cent. of these bats carry the rabies virus in their saliva. They bite the peoples' toes at night and the rabies appears as an ascending paralysis that looks in many ways like infantile paralysis. It was necessary that the bat population be reduced. This campaign and one against the mosquitos in that region were planned by the Medical Intelligence.

"Among the so-called 'filth' diseases, typhoid is licked since all troops get immunization," Professor Meyer said. But when our boys come home they may bring back dysentery in various forms." Dysentery vaccines are being studied but they are still in an experimental state. Sulfaguanidine has revolutionized the treatment. This disease will have to be controlled by environment, such as suppression of flies and proper disposal of excreta. This means continual vigilance.

We shall also have contact with cholera, Professor Meyer pointed out, since we are going close to the birthplace of cholera in the Ganges delta. There is a vaccine, but the degree of protection afforded is not definitely known. The Japs have used cholera vaccine since 1904. In fact, the best strain is a Japanese strain. The disadvantage is that revaccination is necessary every three months.

Among the insect-borne diseases we find malaria, which is more frequent in the tropics. This disease is not conquered. We need a real phophylactic. We now have only a suppressive, and a person may carry malaria for years in his blood. The control of this disease will have to be through control of mosquitoes. But how can any one prevent them from breeding in the hills, for example, of the Owen Stanley Mountains, or in West Africa? The medical officer can only see that the men sleep under mosquito nets and charge the atmosphere of the tents with insecticidal spray.

Against yellow fever the army has a vaccine which gives 100 per cent. protection.

Bubonic plague is always a possibility. This scourge has played an important role in many previous wars. It is insect-borne but once started may be passed from man to man in the pneumonic form. Both a vaccine and sulfa drugs may help fight plague.

Typhus is an ever-present threat. The British found typhus in Egypt. It is apt to be in any country where the population is louse-infested. "Some believe this can be handled by vaccination," Professor Meyer said, "but I have yet to be convinced."

In New Guinea, Sumatra, Burma, and Thailand there are mites that transmit a type of spotted fever similar to the swamp fever of Japan. In North Africa troops will probably experience similar diseases carried by ticks. In Central Africa we find sleeping sickness. To combat this we have a prophylactic, Bayer 205, which gives protection for three months.

There are also many other medical problems in a global war. In desert warfare heat-stroke must be dealt with, and sinus infections that tend to flare up. In the swampy battlegrounds there are liver flukes. In our army of eleven or twelve million men we shall find only the particularly fit individuals can be sent into certain regions. A great many who have been sent will have to be returned and replaced by others.

PENICILLIN AND GONORRHEA

RAPID recovery from gonorrhea in five patients who had not been helped by sulfa drug treatment was achieved by the new remedy, penicillin, is reported by Dr. Wallace E. Herrell, Dr. Edward N. Cook and Dr. Luther Thompson, of the Mayo Clinic, in the *Journal* of the American Medical Association.

Penicillin, which is obtained from common mold similar to that which grows on bread, is available only in limited amounts. It should, therefore, be reserved as a drug of last resort in treating gonorrhea.

Some strains of gonococci are so resistant to sulfa drugs that the patients fail to recover even with large doses and several courses of treatment. Laboratory tests showed that such sulfa-drug-resistant strains would yield to fairly small amounts of penicillin. The patients treated at the Mayo Clinic had been sick with gonorrhea for from five weeks to eleven months and had all had what would be considered adequate sulfa drug treatment. They began to get better within a few hours, in one case within five hours, after the penicillin solution started dripping into their veins, and in from two to four days were able to leave the hospital completely free of the infection. Lab-

oratory tests showed the germs had been banished in from 17 to 48 hours. The penicillin was given by continuous drip into the veins. No toxic effects or discomfort to the patient resulted from the treatment.

SYNTHETIC RUBBER PRODUCTION

SYNTHETIC rubber of the Buna S variety, good for tires all the way from jeep to super-bomber sizes, as well as for tank treads and other Army uses, will flow at the rate of 90,000 long tons a year out of a new plant set-up at Charleston, West Va., which has just gone into full-scale production.

Government-owned, the new installation consists of two separate but closely integrated plants, each under the management of a well-experienced industrial organization. The first plant, where the raw materials are produced, is managed by the Carbide and Carbon Chemicals Corporation; the second, where they are converted into the final product, by the United States Rubber Company. The two plants stand side by side, so that a casual observer would think they were one; short pipe lines carry the raw materials from one to the other.

Scarcely over a year ago, there was nothing on the broad, flat plain by the Kanawha River but farm and pasture land adjoining a small airport, near the suburban station called Institute, from the presence there of a state teachers' college. Now the place is an industrial giant, capable eventually of making rubber to rim 16,000,000 civilian car wheels every year.

Buna S is the synthetic rubber made by mixing two organic compounds, butadiene and styrene. Butadiene in turn can be made from either petroleum or alcohol; at this plant alcohol is used. The alcohol is brought up the river by barge or in railroad tank cars; it comes from the great Ohio Valley distilleries that have stopped making liquor to devote their entire capacities to war-alcohol production. A "tank farm" with a total storage capacity of 750,000 gallons insures a constant working supply on hand.

Styrene, the other ingredient, is made here by combining benzene and ethylene. Benzene is produced in abundance near by; it is a coke-oven by-product, and there are many coke-ovens in this valley. Ethylene is one of the lighter petroleum fractions.

Both butadiene and styrene must be brought to a high degree of purity before they can successfully combine to produce Buna S. At this place, the Carbide and Carbon Chemicals plant brings the butadiene to 98.5% purity and the styrene to 99% before putting them into the pipe lines to go over to the United States Rubber plant.

Both chemicals are limpid, water-clear liquids as they flow into the great mixing vessels. As soon as they are well in contact, however, they combine to form a milky fluid—a true latex, filled with billions upon billions of submicroscopic rubber particles.

These are held from combining with each other because all have electrical charges of like sign. The latex is flowed into another great vat, where a salt-water solution containing a little sulfuric acid is mixed in. The salt removes the electrical charges, and the rubber particles stick together in grains or crumbs. These are put through a mechanical shredder and washed thoroughly, to remove all chemicals that may still cling to them. Finally the raw rubber particles are showered down into the oblong mold of a powerful press, that squeezes them into 75-pound blocks. These are packed in cartons for shipment to the tire factories.—FRANK THONE.

ITEMS

EXPORTABLE quinine-bearing bark from the 17,000-acre cinchona plantation at El Porvenir, Guatemala, will be obtained under an agreement announced by the Board of Economic Warfare. A fourth of all Latin-American production is expected to come from El Porvenir. Guatemala is the only source that can supply the anti-malarial drug to this country by land route. A laboratory already has been established at El Porvenir for testing and analyzing bark and studies are being made of the different types of trees found there. It is hoped that a training program may also be undertaken to school people for work in locating and testing other cinchona stands in neighboring republics.

THE potato famine should soon be over. Commercial early potatoes from 363,100 acres of land are ready or soon will be ready for the market. It is an acreage 17 per cent. greater than the early potato acreage for 1942, and 16 per cent. above the ten-year average, 1932–41. Reports just made to the U. S. Department of Agriculture by its crop correspondents and field statisticians indicate the acreage in the states of Georgia, Kentucky, Maryland, Virginia and Kansas is 9 per cent. above the acres harvested in 1942, but is nearly 22 per cent. below the ten-year period. Arkansas, Oklahoma, Tennessee and North Carolina are expected to produce nearly 7,000,000 bushels, an increase of over a million bushels above the amount raised in 1942. The floods of the Arkansas and other rivers in Oklahoma and Arkansas have destroyed many acres of growing potatoes, but the increased acreage in other states will more than balance the losses.

ACCORDING to the Metropolitan Life Insurance Company "in this country as a whole, about six out of every 100 men and women of marriageable ages wed during a typical year." For the South, the figure has been almost nine out of 100, and for the Far West it has been somewhat under five out of 100. The North has been about halfway between. Now the West is having more marriages, especially in the ages under 35, while the South is having fewer. An increase in marriages among the older people and fewer marriages among younger ones is predicted for the future as a result of the war. The company also reports that the current death rate among white children aged 5 to 14 years is under one per 1,000. This is half the rate prevailing only a year ago. There is still considerable room for improvement, the statisticians point out. The five chief causes of death among children of school age are, in order of numerical importance: accidents, appendicitis, influenza and pneumonia, rheumatic fever and tuberculosis. Accidents cause more than a fourth of all deaths of school children in America. These can be prevented and the killing of children by the four diseases can be greatly reduced by further efforts to protect child health.

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WHERE ANGELS FEAR TO TREAD: A CONTRIBUTION FROM GENERAL SOCIOLOGY TO HUMAN ETHICS[1]

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INTEREST in the social impact of science in general and of biology in particular has been growing steadily in the last few decades. The problems imposed by the present war and by thoughts of the coming post-war world have increased this interest. My own active concern with various phases of the sub-social and social life of non-human animals has revealed enough of the complexities of these simpler social systems to make me well aware of my limitations when confronted with the modern social problems of men. It is the drive of immediate necessity rather than a feeling of competence that impels me to undertake the present discussion of the biological foundations for some fundamental phases of the social behavior of men.

[1] Proposed address as vice-president and chairman of Section F of the American Association for the Advancement of Science.

I. THE BIOLOGICAL EVIDENCE

In our laboratory we are making two experimental approaches to the phenomena of biological sociology, and each yields its very different aspect of truth. On the one hand, we have been studying for over a decade the dominance-subordination relations that are characteristic of many social groups. We know from personal observations, as well as from the literature, of nip-orders in fish, peck-orders in flocks of several species of birds and fighting orders in mice. Usually there is one dominant animal which can bite, nip or peck others without being attacked in return. Below it the others are ranked in various degrees of subservience. Similar dominance orders occur among such mammals as rats, cats, cows and men. Social organizations have also been reported with certainty

for turtles and for lizards, as well as for many species of birds and mammals besides those which we have observed.

These social organizations are based immediately on fighting or bluffing ability, on individual aggressiveness or meekness, as exhibited in pair contacts between the different members of the vertebrate group in question. Usually the complete social order within a small group is determined during the first few days of contacts; often, among hens, for example, in the first series of encounters. The order, once established, is not readily upset. With fish, changes occur fairly frequently; but with hens, we have observed the same peck order to persist unchanged for as long as a year, and this is a relatively long time in the life of a hen. These social orders are a real expression of crude, person-against-person competition for social status and furnish fair illustrations of the individualistic, egocentric phase of group biology. Here is an aspect of the individual struggle for existence, and as such it illustrates an important phase of the Darwinian theory of evolution.

High position in the social peck order confers privileges. We know that top-ranking animals feed more freely; that high-ranking males of rhesus monkeys, sage grouse and the common domestic fowl have more ready access to females. Low social status may lead to semi-starvation, to psychological castration among cocks, to ejection from coveys of quail; and among many species it forces the low birds into inferior territories. In some cases, high social rank carries responsibilities for leadership or for guard duty; in other instances no correlation with social duties has been demonstrated as yet. Among others, I have published research reports and discussions of many such relationships and need not dwell on them longer.

These studies of individual aggressiveness make one experimental approach to general and comparative sociology. Our second line of attack comes from a different quarter. For more than twenty-five years we have been experimenting with group-centered tendencies which long before my time were called cooperation. Careful students nowadays point out that, among lower organisms, cooperation is entirely non-conscious. In this phase of our study we are investigating natural cooperation somewhat as many other biologists have been concerned with natural selection. Natural cooperation in its simpler forms implies merely that the interrelations between cells, for example, are more beneficial than harmful for the individual, or that the interrelations between individuals are more beneficial than harmful for the given social group.

I have added to and reviewed repeatedly the modern evidence concerning the existence of such cooperation. Mere repetition does not necessarily make for acceptance, but a good purpose may be served by summarizing in outline form the types of modern evidence that I have found compelling; the details can be filled in from the extensive literature.[2]

(1) At all levels of the animal kingdom, and under a variety of conditions, there is added safety in numbers up to a given point. Animals from the protozoans to insects or man meet many adverse conditions better if optimal numbers are present rather than too few. There is danger also in overcrowding, but I am emphasizing just now the danger of the population being too sparse. For certain animals this sort of mass protection exists when the organisms are exposed to heat. Mass protection from cold is more common, as is protection from many poisons and from other harmful chemicals. Optimal numbers also protect from ultra-violet radiation, from radical changes in osmotic pressure and from many environmental deficiencies.

Macerated cells of a sponge will not regenerate if too few are present and the smallest embryonic grafts frequently fail to grow when somewhat larger ones succeed. If a natural population falls too low, it is in danger of dying out even though theoretically able to persist.

(2) In keeping with the relations just outlined, many organisms, both plants and animals, are able so to condition an unfavorable medium that others following or associated with them can survive better and thrive when they could not do so in a raw, unconditioned medium.

(3) Certain vital processes are adaptively retarded by increased numbers up to a given density. For example, scattered spermatozoa of many marine organisms lose fertilizing power more rapidly than they do when they are massed together.

(4) Other biological processes are accelerated, perhaps beneficially, in the presence of populations of optimal size and density. Such processes are slowed down both in over-sparse populations and in those that are overcrowded. Cleavage rate in Arbacia and certain other eggs follows this rule. Various kinds of Protozoa show acceleration in rate of asexual reproduction with medium rather than sparse population density, and similar phenomena may well have been a forerunner of

(5) The evolution of the cooperative processes which are associated with sexual reproduction.

(6) Colonial protozoa could hardly have evolved from solitary forms unless the simple colony of cells that remained attached after divisions had shown cooperative powers that were lacking when the cells were scattered singly. The evolution of the Metazoa from the Protozoa was probably based on similar relationships.

[2] W. C. Allee, "The Social Life of Animals." 283 pp. New York: Norton. 1938.

(7) Each advance in complexity of metazoan individuals came from the natural selection of an increased ability in natural cooperation on the part of the evolving stock; the greater natural cooperation came first, and then it was selected.

(8) Darwin[3] recognized that a relatively large population is a highly important factor in natural selection. Sewall Wright and others have evidence that evolution proceeds most rapidly in populations of interbreeding organisms that are intermediate in size, as compared with similar populations which are over-small or over-large.

(9) The interdependence of organisms is shown by the repeated observation that all living things, from the simplest to the most complex, live in ecological communities; this is plainly seen in the many biocoenoses, such as those of the oyster bed. Further, the evolution of truly social animals has occurred independently in widely separated divisions of the animal kingdom. These could hardly have arisen so frequently and from such diverse sources if a strong substratum of generalized natural cooperation were not widespread among animals in nature. In nature no animal is solitary throughout its life history.

(10) As with the individual organisms, each advance in complexity of the social life of any group of animals is based on the development of some means of closer cooperation between the individual units of the evolving group.

We have good evidence then that there are these two types of social or sub-social interactions among animals: the self-centered, egoistic drives which lead to personal advancement and self-preservation, and the group-centered, more-or-less altruistic drives that lead to the preservation of the group or of some members of it perhaps at the sacrifice of many others. The existence of egoistic forces in animal life has long been recognized. It is not so well known that the idea of the group-centered forces of natural cooperation also has a respectable history. I take time to give a bare outline of the growth of this idea and to mention some of its proponents because many professional and lay students are interested in the men who have accepted an idea as valid as well as in the evidence that supports it.

The germ of the concept of natural cooperation, along with that of natural selection, can be traced to the biologically absurd poetry of Empedocles about the middle of the fifth century, B.C. Thereafter the principle was kept feebly alive by the succession of thinkers from Aristotle to Herbert Spencer and beyond, who saw human society as a natural outgrowth rather than as an artifact.

More positive emphasis on the "altruistic" interpretation began with the third Earl of Shaftesbury who, about 1700, recognized clearly that racial drives exist which can be explained only by their advantages to the group. He thought that there is a natural goodness about men and recognized that other animals may be kind to associates of their own species. Adam Smith, in his "Theory of Moral Sentiments," wrote in 1759 of the same qualities under the heading of "sympathy" or "fellow feeling." His more famous "Inquiry into the Wealth of Nations" (1776) is based on the opposed forces of self-interest and he did not publicly reconcile the two. Later Comte (1798–1857) emphasized "altruism" as Feuerbach (1804–1872) did "love." These relationships are reviewed sympathetically by Lange (1875) in his remarkable "History of Materialism."

Herbert Spencer argued now for egoism and again for altruism. In 1901 he balanced the two following quotations from his "Principles of Ethics": "If we define altruism as being all action, which in the normal course of things, benefits others instead of benefiting self, then, from the dawn of life, altruism has been no less essential than egoism. Though primarily it is dependent on egoism, yet secondarily egoism is dependent on it."

Darwin, in the "Origin of Species" (p. 215) recognized that evolution within the worker caste of ants can be explained by remembering that selection can act on the family as well as on the individual and Weismann[3a] in 1893 underscored the point. Such ideas are in keeping with Darwin's use of the phrase "struggle for existence," of which he said: (p. 46) "I use this term in a large and metaphorical sense including dependence of one being on another and including (which is more important) not only the life of the individual, but success in leaving progeny."

In the "Descent of Man" (1874), Darwin gave Kropotkin-like naturalistic examples of mutual aid; and we can readily see that Darwin's whole thesis that man is descended from other animals requires that man's altruistic drives have precursors among his animal ancestors. Darwin clearly derives the moral sensibility of man from his "social instinct" played upon by reflective intelligence and states (p. 122): "The term, general good, may be defined as the rearing of the greatest number of individuals, in full vigour and health, with all their faculties perfect, under the conditions to which they are subjected. As the social instincts both of man and the lower animals have no doubt been developed by nearly the same steps, it would be advisable, if found practicable, to use the same definition in both cases, and to take as the standard of morality, the general good or welfare of the community. . . ." He recognized group-focused tendencies in the higher mammals. He did not, as

[3] "Origin of Species," Murray's Library Edition, p. 74.

[3a] August Weismann, *Contemp. Rev.*, 64: 309–338. 1893.

nearly as I can judge, sense the existence of the reservoir of sub-social and social tendencies of which Espinas[4] wrote in 1878.

Geddes and Thompson comment in their book called simply "Evolution" (p. 167), which was published in 1911, that "Darwin's characteristic fundamental idea of the intricacies of the interrelations in the web of life lies below the idea of natural selection." Later, in speaking of family and group selection, they continue: "Though Darwin did not wholly overlook this (indeed in one notable passage he expresses it) there is no doubt that the general tone and treatment of Darwinism, even hitherto, has been colored by the acute individualism of Darwin's and the preceding age."

Evidence that the egoistic emphasis was common in British scientific circles during Darwin's later life, and that group-centered interpretations were novel is found in a news note from *Nature* for January 21, 1880: "We notice an important communication by Prof. Kessler at the annual meeting of the St. Petersburg Society of Naturalists on January 8 [1880] on the 'Law of Mutual Help' as one of the chief agents in the development and progress of organisms. Prof. Kessler, although an able follower of Darwinism, thinks that the struggle for existence would be insufficient to explain progress in organic life, if another law, that of sociability and mutual help, did not powerfully work for the improvement of the organism and for strengthening the species."

Espinas (1878), two years before Kessler's lecture, had given a similar interpretation which he supported by the best observations then available. Espinas emphasized the naturalness of the cooperative, social drives. Geddes and Thompson reaffirmed a similar conclusion in 1911: "We may therefore restate the concluding thesis of our 'Evolution of Sex' (1889) since elaborated in various ways by Drummond, by Kropotkin and others. It is that the general progress both of the animal and plant world, and notably the great uplifts, must be viewed not simply as individual but very largely in terms of sex and parenthood, of family and association; and hence of gregarious flocks and herds, of cooperative packs, of evolving tribes, and thus ultimately of civilized societies. . . ."

The idea did not catch general scientific attention despite the emphasis placed on such an interpretation by Delage and Goldsmith (1912),[5] Reinheimer (1913, 1920), and William Patten, who in 1920 made the cooperative principle the central point in his "grand strategy of evolution." The neglect continues despite the repeated emphasis given by William Morton Wheeler (1923, 1930), despite my own summaries of supporting evidence and the more recent adoption of this point of view by Emerson (1942), Gerard (1942) and others whose opinions should carry weight. Today, as in Darwin's time, the average biologist apparently still thinks of a natural selection which acts primarily on egoistic principles, and intelligent fellow thinkers in other disciplines, together with the much-cited man-in-the-street, can not be blamed for taking the same point of view. Personally, I was well and thoroughly trained in this orthodox biological doctrine. For example, it was clearly stated in the first chapter of a book published in 1913 by my stimulating friend and former teacher, Professor V. E. Shelford.[6]

As was shown earlier, both egoistic and group-centered forces exist in nature and both have been brought under experimentation. I had wondered for years whether we could experimentally test for possible relationships between these two basic phases of animal behavior. Might organized groups of birds, to take one possible instance, have survival values for the group in general as a result of their organization, even though there were no signs of an organized group defense? It will be remembered that such a group organization is based on individual aggressiveness and yields survival values for the high-ranking individuals in the peck order.

I have not yet been able to devise an elegant experiment to test the point. The best one I have been able to think up has been in progress for over nine months. Briefly, we have three flocks of line-bred hens which have been allowed to become organized and are kept as controls. In a similarly housed neighboring flock of the same stock, a new hen is added daily or every second day and the hen which has been longest with the flock is removed and placed in isolation for twenty-one days or more before she is again introduced into the experimental flock. By that time, apparently, she has forgotten all other hens as individuals; hence the experimental flock is in a state of continual reorganization.

I can not take time for details and without them you will be unable to make a critical judgment con-

[4] A. V. Espinas, ''Des sociétés animales.'' 588 pp. Paris. Librairie Ballière.

[5] Y. Delage and M. Goldsmith, ''The Theories of Evolution.'' 352 pp. London: Palmer. 1912. H. Reinheimer, ''Evolution by Cooperation; a Study in Bioeconomics.'' 200 pp. London: Paul, Trench, Trübner and Co., Ltd. 1913. H. Reinheimer, ''Symbiosis, a Socio-Physiological Study of Evolution.'' 295 pp. London: Headley Brothers. 1920. W. Patten, ''The Grand Strategy of Evolution.'' 429 pp. Boston: Badger. 1920. W. M. Wheeler, ''Social Life among Insects.'' 375 pp. New York: Harcourt Brace. 1923. W. M. Wheeler, ''Social Evolution.'' Chapter IV in ''Human Biology and Racial Welfare.'' 612 pp. E. V. Cowdry, ed. New York: Hoeber. 1930. A. E. Emerson, ''Basic Comparisons of Human and Insect Societies.'' Biol. Symposia VIII, 163–177. 1942. R. Gerard, ''Higher Levels of Integration.'' Biol. Symposia, VIII, 67–87. 1942.

[6] V. E. Shelford, ''Animal Communities of Temperate America.'' 362 pp. Univ. of Chicago Press. 1913.

cerning the value of the experiment. An individual can effect the quality of the group life in these flocks; still, despite differences in individuals, the indications are that, regardless of the individuals that may be present, the organized flocks eat more, maintain weight better and spend less energy in fighting, bluffing and pecking each other than is the case with the flock that is daily subjected to reorganization. The strong suggestion is that an organized flock of hens has survival value as a flock which is lacking among an otherwise wholly similar group of hens, that is never allowed to become socially stabilized.

With all its imperfections, the experiment suggests that person to person competition, if not too severe, may lead to group organization which increases the effectiveness of the group as a cooperating social unit in competition or cooperation with other social organizations. Such a conclusion had been suggested by naturalistic evidence. Other data, certain types of which have already been summarized, indicate that cooperation at the individual level may also yield groups with increased competence in competition or cooperation at the group level. Any group organization, however achieved, may be helpful under many conditions. There is suggestive evidence that the relations between individuals which form a simple group of the first order are repeated between such groups when compounded into a unit of a higher social order. Even when society becomes still more complex, the relationships remain essentially similar. Throughout the higher social categories, there may be group-centered egoism and tendencies toward inter-group cooperation at one and the same time.

With cosmopolitan species, whether of human or of non-human animals, in last analysis, the cooperative units tend towards being world-wide in scope. If in its spread over the globe the common house sparrow becomes a new host for a virulent disease organism, the welfare of the whole species may be affected. Sessile eel grass has been devastated on the Atlantic coasts of Europe and of North America by the same mycetazoan parasite. The conclusions that I have been discussing are based primarily on objective studies with non-human animals. They are supported by much evidence from the interrelations of men; and the global scope of the cooperative interests of *Homo sapiens* are more obvious and have more possibilities for development than have those of any other species.

The picture that emerges from the cumulative studies on social biology is one in which cooperations and their opposite, disoperations, both exist. There are both egoistic and altruistic forces in nature, and both are important. The question arises insistently as to which of these is more fundamental and potent. Any such evaluation must be based on both short-run and long-run effects. After much consideration, it is my mature conclusion, contrary to Herbert Spencer, that the cooperative forces are biologically the more important and vital. The balance between the cooperative, altruistic tendencies and those which are disoperative and egoistic is relatively close. Under many conditions, the cooperative forces lose. In the long run, however, the group-centered, more altruistic drives are slightly stronger.

If cooperation had not been the stronger force, the more complicated animals, whether arthropods or vertebrates, could not have evolved from the simpler ones, and there would have been no men to worry each other with their distressing and biologically foolish wars. While I know of no laboratory experiments that make a direct test of this problem, I have come to this conclusion by studying the implications of many experiments which bear on both sides of the problem and from considering the trends of organic evolution in nature. Despite many known appearances to the contrary, human altruistic drives are as firmly based on an animal ancestry as is man himself. Our tendencies toward goodness, such as they are, are as innate as our tendencies toward intelligence; we could do well with more of both.

II. Some Implications

Now I come to the more delicate part of my task. In discussing the further implications of the evidence and conclusions just presented, I am, as much as is possible, speaking in my private capacity as an American citizen with generations of American ancestors. I am both a mature biologist and a working member of a religious organization. The ideas I shall express are not necessarily those of the American Association for the Advancement of Science or of any of its sections; neither are they to be interpreted as the views of the university at which I work or of any other formal or informal organization. If at times I seem to place myself as a spokesman for all scientists or for biologists in general, please remember that I am giving my personal views and am not attempting an authoritative interpretation of the opinions of others.

As I see it, our present-day civilization is based primarily on religion, on other forms of tradition and on science. The arts furnish color and interpret the behavior and thinking of the human participants. Philosophy busies itself, or should, with trying to understand and explain the whole. The functioning of our type of civilization, if it is to be properly effective, calls for the cooperation of all these forces.

To-day, as in the past, religion wastes valuable time and energy quarrelling with science about their relative importance and over the proper division of functions, a quarrel which nowadays scientists largely ignore. Philosophy stages jurisdictional disputes with both. Too often art becomes cynical and irresponsible,

and philosophy scolds all and sundry, sometimes in no friendly voice, for the general unwillingness to let philosophy direct the whole.

Philosophy insists, even yet, on its discredited age-old claim of having a special short cut to knowledge. Particularly philosophy scolds science, the most recently revitalized force in civilization; and modern religion, having attempted to use science to establish its claims, tries to carry on alone in some of the most vital activities of our times.

Here, as elsewhere in human efforts, it is easier for closely knit elements in a situation to develop and react to frictions among themselves than it is to disregard relatively petty internal troubles and make common cause against serious opposing forces. The forces in opposition to the better aspects of our none-too-perfect civilization are strong enough to demand united efforts from the arts, philosophy, science and religion if they are to be properly met. Perhaps plain speaking from a somewhat unorthodox friend of all these elements of civilization may be helpful.

Religion has much to learn from science in objectivity, in willingness and courage to follow evidence fearlessly and even in judging what constitutes valid evidence. Particularly religion can learn from science the advantage of giving up the thundering "thus saith the Lord" in favor of the more humble and essentially more effective summary of "this appears to be the evidence." In short, religion can profit by becoming intellectually more sound without losing for a moment its proper emphasis on the deep emotions of man.

And science has much to learn from religion. I mean from real religion, not from the pseudo-science of theology which, too often, consists mainly of expert verbal manipulations, related to scholasticism rather than to science.

Apparently I must take time to suggest what I mean by religion. Religion is ill-served by past and present emphasis on mystical and supernatural improbabilities. To me "God" is a possibly permissible name for the personification of all the best that the human race has been able to think and do and of all the beauty we have created, together with all the natural beauty we can appreciate. Such a conception transcends tradition and mere emotion and has both power, and dignity. While by no means final, this is as close an approach to the truth as real evidence permits at present.

Science has much to learn from such a religion as I have just outlined, a religion characterized by unselfish living and honest thinking combined with propaganda of the deed. More specifically, scientific men can profit by greater humbleness in the face of our immense ignorance about matters well within our several fields of professed competence. We can also dispense with excessive pride in the usually small discoveries we are able to make.

We scientists can profit by a frank admission of our awe and admiration for the pervading beauty of the phenomena we study, the charm of which often escapes us because of our preoccupation with details. We will profit by being less certain that the more unpalatable the interpretation, the closer the approach to truth. We will gain in the long run by working in our chosen fields more inconspicuously and quietly. Science, and mankind too, will profit by scientists who live closer to the ideals expressed and practised by the more devoted men of science or of religion.

I could make these suggestions in stronger language were it not for the fact that from a fairly wide and close acquaintanceship with many kinds of people, individual exceptions aside, scientists in general and biologists in particular seem the best people I know. This may be an expression of prejudice based on congeniality of temperament. I am inclined, however, to regard the difference between my scientific and my other friends as real and to attribute it to the training furnished by scientific practises.

The biological sciences impose an especially effective discipline in that they combine an impressive amount of precision in detail with a large content of imponderables. The combination is the more effective in that a mistake in judgment concerning the imponderables is usually exposed relatively soon by some precision measurement. The continuous checking of ideas against evidence does something to make conscientious followers of the scientific method essentially more honest and less given to the self-deception, which is one of the weaknesses among those skilled primarily in the manipulation of ideas or of words.

As with followers of other disciplines, we scientists are very human. Our frequent preoccupation with "my status," "my experiment," "my theory," "my priority" and even with "my little bug" is a source of weakness for which correction can be found in a closer approach to the ideals of science or of religion.

Despite my firm belief in the essential goodness of my biological colleagues, I must admit that advanced laboratory study and the introduction to research does not automatically produce some of the higher types of altruism. When recurrent opportunities come to recommend some one to teach biology in a deserving though struggling Negro college, or in remote, ill-equipped, much-needed Chinese or Hindu laboratories, I have learned to turn to students with a strong religious background for men with vision enough to see that the opportunities may, in the long run, repay the sacrifices.

Let us take another approach. No one of us passes much time without being reminded that we are living

in a world at war and in a country that is closely engaged in that war. We went into this present conflict with, on the whole, commendable calm, and the war is being prosecuted more efficiently because wartime emotions are at a minimum as yet. It is questionable how long this frame of mind will continue. Our sons and friends and students are engaged on many fighting fronts and tension mounts as the casualty lists trickle through. We need to examine frequently our responsibilities as biologists in our world to-day, for, like other animals, biologists do not live in a vacuum insulated from the impacts of their time.

It has come as a shock to many that their hard-won biological skills are of so little direct use in the war. The closer the approach to preventative or curative medicine, the greater the immediate applicability of our biological training. It is true that in the war effort there have been some fairly amusing practical applications of highly impractical phases of biology, for it is impossible to predict what bit of pure science of to-day will be the basis for the applied science of to-morrow.

For most, particularly for those of us in the upper-age brackets, we must continue for the foreseeable future at our present jobs or at something closely approximating them. We may need to shift teaching and research somewhat; many have already done so. Primarily, however, our main job must be to remain steadfastly at our usual, routine tasks. These are by no means unimportant even for a world at war. The younger generation needs as many steady points of reference as possible in their rapidly shifting world. This need is tacitly admitted when they come, as they do, to talk themselves quiet in the presence of a sympathetic, calm, older person in whom they place some confidence.

We have a heavy responsibility to our younger friends and students in the armed forces of the world, in the civilian public service camps, in concentration camps or in prisons, so to act that they have a recognizable world to which to return. We, as well as they, have our responsibilities to defend and later to rebuild our civilization, using the techniques we know best. Our phase of the task is as important as it is undramatic.

In the present and immediate future we have the task of helping maintain our forms of government both locally and nationally. Closer home, we have the pressing work of maintaining academic standards and the honesty of academic credits, certificates, fellowship and other awards and even of academic degrees.

In addition to attempting to maintain present levels of competence in intellectual training, we need to give full play to all usable forces that make for emotional stability. Admittedly we are highly ignorant concerning methods for the education of the emotions at the college or graduate level. Mainly we trust to the added stability that comes with maturity. We need to pool our ignorance and attempt positive steps towards training emotion as well as intellect. We have some hints on which to work. Project methods of laboratory study can be helpful as can volunteer summer work camps, honest competitive group sports and many kinds of informal group living. The difficulty of the task and ignorance of how to educate the emotions does not warrant us in continued neglect of this important phase of education.

For the somewhat more remote future, there is an obligation that rests with especial weight on biologists to attempt to make sure that mankind does not lose the peace that will follow this war. We have less hope of winning the peace if all of us become emotionally engulfed in the war. Among other consequences of this duty not to lose the peace, we have an obligation to keep fundamental research projects going even in wartime. I am fully convinced that those nations will have the best opportunity to win the peace who emerge from the present conflict with their program of basic research most nearly intact. This includes the necessity for maintaining a supply of trained research workers in the basic disciplines and the retention of enough of the brilliant younger men to ensure a steady trickle of researches in a great variety of academic fields, many of which are far removed from the immediate war.

Biologists, as their part of the war effort, are searching with almost frantic haste for new techniques for patching up men's bodies and for solving problems of adequate nutrition for ourselves and our associates. This introduces another phase of the relation of science to war that must be faced honestly. Science is the maker and user of gadgets as well as the discoverer of the shadowy outlines of the tools of the future. Science is fighting this war in laboratories all over the world that were built to search impartially for basic evidence, for the truth, as we naively used to say, and for all people, not for one group or another.

The success of scientists in helping to win the war will be used to blame science itself later. When the war is over, the scientists who are now so praised and courted on almost all sides will be told in no uncertain terms, as we have been in the past, that the war itself was all our doing. And there will be insistent calls from many whose motives are not altogether disinterested, for a moratorium on scientific research lest bigger and more destructive wars have to be fought in the future. Such anti-scientists will forget the long series of vicious wars that were fought before science became a major force in our civilization. There will be some truth in the accusation, for biological science is not wholly free from war guilt. This is not only

because we have been the inventors of tools for mass destruction but because we have been responsible for giving interpretations to some aspects of Darwinian theories of evolution that provide a convenient, plausible explanation and justification for all the aggressive, selfish behavior of which man is capable.

Herbert Spencer in 1901 in his "Principles of Ethics" gave a mild statement of this doctrine (p. 189): "But to say that each individual shall reap the benefits brought to him by his own powers, inherited and acquired, is to enumerate egoism as an ultimate principle of biological conduct. . . . Under its biological aspect this proposition can not be contested by those who agree in the doctrine of evolution."

T. H. Huxley[7] asserts the same principle and characteristically steps up the emphasis. In speaking about primitive men and "their less erect and more hairy compatriots," Huxley's statement was: "As among these, so among primitive men, the weakest and stupidest went to the wall, while the toughest and shrewdest, those best fitted to cope with their circumstances, but not the best in any other sense, survived. Life was a continual free fight and beyond the limited and temporary relations of the family, the Hobbesian war of each against all was the normal state of existence." Huxley's general position was that amelioration of this egoistic struggle was a contribution made by "ethical man" despite his animal ancestry. Ernst Haeckel[8] took a wholly similar point of view.

According to this interpretation, the altruistic drives of man are primarily human attributes that arise from the development of sympathies at the human level and are connected with the mass of animal behavior by a very slender stalk. We know, for example, that the aggression of hens high in the peck-order may be modified by individual tolerances towards certain of their subordinates in a manner that strongly suggests human personal preferences. Also it appears that male chimpanzees show a chivalry pattern towards females that are in oestrus. Such modifications of aggressiveness are weak foundations on which to base the idea of a natural drive toward altruism among men. In fact, it is a fairly common interpretation that such altruistic drives as exist are based primarily on some sort of enlightened selfishness.

It is not to be wondered that apologists for human behavior seized on the doctrine so authoritatively set forth, as a proof that man, having descended from other animals, had inherited fighting tendencies which it was almost useless to resist. The natural fate of all was to engage in a physical struggle for existence softened only by slight checks imposed by more or less artificial rules for human conduct.

The biological support for this fatalistic view regarding, among other things, the inevitableness of intra-species human conflict, is now opposed by strong evidence which indicates that the idea of a ruthless struggle for existence is not the whole, or even the major contribution of current biology to social philosophy and social ethics. This newer evidence, which was outlined earlier, does not cast doubt on the existence of the human vices of pride, covetousness, lust, anger, gluttony, envy and sloth and it does not remove indications that they find natural roots in infra-human behavior. The newer findings do strengthen decidedly the older evidence for a biological basis for the human virtues of faith, hope and love and supply renewed indications that men inherited these tendencies too. This strongly suggests that the present high state of development of the seven capital sins just named is mainly a result of man's learned devilishness rather than his inevitable response to inherited nature. On the other hand, we know too that man has been able to enlarge greatly his natural drives toward being godlike.

From such considerations, I insist again that the data of biology, if properly understood, do not furnish sound support for a social philosophy based primarily on the idea that might makes right in interpersonal contacts or in international relations. Those who assert that the whole trend of science is to lend support to the present war system in settling international disagreements are relying on a mistaken, outmoded phase of biological thought to bolster up a much older and unreasoned drive toward conflict. The philosophy that condones war is not based on all the biological evidence or on recent interpretations made in the light of that evidence. Science is indeed largely responsible for designing the tools with which men fight and for undue emphasis even in the recent past on some of the implications of the Darwinian doctrine. Otherwise scientists as such bear only their proportionate share of the responsibility for the misuse man is making of the powers we have discovered and placed in his hands.

When this war does end, the intelligent public should have much to say about the terms of a just and workable peace. Happily there is interest in this subject among responsible biologists and I want to encourage continued consideration of all its complicated ramifications. Such a study will emphasize again the unity of all the forces that make for civilization. For example, certain phases of modern biology furnish a basis of objective evidence for the age-old religious insight that the fundamentals of a just and enduring peace are to be found in a positive ap-

[7] T. H. Huxley, "Evolution and Ethics and Other Essays." 333 pp. (pp. 203–4). Macmillan, London. 1894.

[8] Ernst Haeckel, "Freie Wissenschaft und freie Lehre." 106 pp. (p. 73). Stuttgart. 1878.

plication of the rule: behave towards all others as you would have all others behave towards you.

Speaking for the moment as a humanist, rather than primarily as a biologist (the two points of view are not unduly dissimilar) there are some implications of this ethical rule as applied to the coming peace which I shall outline. It should be understood that the biological drives toward natural cooperation support the general tenor of the following program without favoring this or any other precise formulation of proposed social action.

(1) We are not to look forward to punishment for defeated *peoples* at the close of the present war.

(2) In under-nourished Europe and elsewhere as needed, administer relief according to ability to furnish it and to need only, not according to politics or boundaries.

(3) Set up a world organization which will, in principle from the start, and in detail as much as possible, treat victors and vanquished alike. This implies similar treatment of all peoples with regard to:

(a) Disarmament; if we disarm other nations, we must be willing similarly to disarm ourselves.

(b) International police; if we subject any major portion of the world to the control of an international police force, we, ourselves, should accept a similar control on the same general principles.

(c) Curtailment of sovereignty; national governments of powerful, along with those of weak peoples, must discontinue the present policy of determining their own actions in all matters deemed by themselves to lie within the limits of their own national interests.

(d) Educate all alike for the processes that make for change by the use of peaceful, non-violent techniques. All nations and many classes within nations do and will continue to need such education for a long time to come.

(e) Behave towards the defeated peoples from the outset more as the English treated the Boers or the United States treated the Filipinos at the turn of the century rather than as our carpet-bag governments coerced the South after 1865 or as England governs troublesome India; and by all means not as Nazi Germany has treated her victims.

We should not overlook the existence of strong, competitive, egoistic drives among all animals, ourselves included. These must be duly considered in any workable plan for a world order. Our job is to keep them in their true place, somewhat subservient to the even more fundamental cooperative, altruistic forces of human nature. They should not again be allowed to steal the international show. These competitive urges can serve mankind well if turned to their original function of driving man in his struggle against his enemies among other species of living things. This struggle is on a global scale, and the members of all countries and races can unite in it. Each can compete against the others for racial, national or personal preeminence in this common task. Competitive drives for worthy ends have real strength. I have only to mention the word priority to a biological audience to make the point.

Consideration of these egoistic drives brings us back again to the hen coops from which we started. Man, like so many of his fellow vertebrates, has a strong tendency to set up social orders among individuals and between groups. In the past, man has made repeated trials of informal and finally of a more formal world organization based on dominance and subordination. There have been the hen-like peck orders of the early world empires to which the atavistic Nazi system is an attempted return. Until recently these rigid peck orders were being replaced by the more democratic dovelike give and take of territorial orders, in which, certain empires aside, each nation had the peck-right over all comers in its home territory. With nations, as with many territorial birds, when space became crowded, the dove-like peck dominance changed to the more despotic peck right.

To-day, a major biological contribution to the discussion of a post-war world is that, solidly as the peck-right system is grounded in animal behavior, it is not the only pattern for human action that biology has to offer. Other animals show a somewhat stronger tendency toward essential cooperations than they do toward struggles for egoistic power. Man can, if he chooses, focus on his innate drives toward cooperation and attempt to set up a new order based primarily on some altruistic pattern such as I have outlined. The task will be easier since modern biological teachings in these matters resemble many of the social doctrines of the ethical religions.

The difficulties in the transition from the power politics of the international peck order to a system based on international cooperation are impressive. The change is possible. If the attempt is deferred for the present, it will most certainly come in the future and I prefer to start toward the future now. If we again turn toward the solutions of the past, we face the disheartening certainty that power politics have never avoided war for more than a few decades and will not avoid war again. We are aided in working toward a more rational goal by the fact that, one or two nations aside, there is a general and strong mind-set toward peace throughout the peoples of the world. Our task as biologists, and as citizens of a civilized country, is a practical engineering job. We need to help arrange so that the existing trend toward a workable world organization will be guided along practical lines which accord with sound biological theory. And we must remember always that in such matters the idealist with the long-range view is frequently the true realist.

OBITUARY

RECENT DEATHS

DR. WILLIAM FRANCIS MAGIE, Joseph Henry professor of physics at Princeton University from 1890 until his retirement with the title emeritus in 1929, dean of the faculty from 1912 to 1925, died on June 5. He was eighty-four years old.

DR. CHARLES F. MARVIN, who retired in 1934 after serving as chief of the United States Weather Bureau for twenty-one years, died on June 5 at the age of eighty-four years.

WESLEY P. FLINT, chief entomologist of the Illinois State Natural History Survey and of the College of Agriculture of the University of Illinois, died on June 3 at the age of sixty-one years.

DR. MARION A. AMES, professor of chemistry and chairman of the Division of Natural Sciences at Elmira College, died on June 4. She was forty-four years old.

EDWIN M. BAKER, professor of chemical engineering at the University of Michigan, died on May 26 at the age of fifty years.

MILNOR R. FREELAND, since 1930 resident chemist at the Presbyterian Hospital of Chicago, died on May 4 at the age of forty-two years.

DR. JOHN W. RITCHIE, science editor of the World Book Company, formerly professor of biology at Maryville (Tenn.) College and the College of William and Mary, Williamsburg, Va., died on May 29 at the age of seventy-one years.

The Cleveland Clinic Quarterly dedicated its April issue to the memory of the late Dr. George Crile, a founder and former president of the Cleveland Clinic Foundation, and prints the addresses that were presented at the memorial service for Dr. Crile at Western Reserve University on January 24.

THE Council of the American Mathematical Society has adopted the following resolution on the death of Professor E. R. Hedrick: "The Council of the American Mathematical Society records its deep sense of loss in the death on February 3, 1943, of Earle Raymond Hedrick. As an active member of the society during four decades of its unprecedented growth and development, he made contributions which were great in number and varied in character. He gave abundantly of his time, thought and energy to the society and served it in the official capacities of council member, trustee, vice-president, president and editor-in-chief of the *Bulletin*. Through membership on many important committees both within the society and outside of it, he labored unceasingly toward the advancement of the interests and prestige of mathematics at all levels. His activities in the Mathematical Association of America, the National Council of Teachers of Mathematics and in numerous engineering and other scientific societies were extensive and outstanding to a degree hard to comprehend in view of his heavy involvement in society and other responsibilities. Professor Hedrick had a rare combination of broad interests, outstanding skill at logical and thorough analysis, good judgment and ability to work effectively with other people. These characteristics invariably singled him out and placed him in a position of leadership."

SCIENTIFIC EVENTS

AVALANCHE RESEARCH IN SWITZERLAND[1]

DURING the War of 1914–18 the number of avalanche fatalities among the armies in alpine regions was very high; in the period between the two wars, the influx of winter visitors to the Alps was followed by an alarming increase in accidents due to inexperience in snow-craft. It became obvious that a proper study of snow and avalanches was needed. There followed the private research work of individuals in many parts of Central Europe, who in turn were succeeded by more elaborately organized groups. In 1934 the Swiss authorities inaugurated a small research laboratory on the Weissfluhjoch close to the upper end of one of the Davos funiculars at a height of 8,500 feet. Under the direction of Dr. H. Bader, a crystallographer, and Dr. M. Haefeli, a civil engineer, much valuable work was carried out ranging from the purely scientific to the severely practical. The former has given us a great deal of new knowledge of the structure and behavior of ice crystals, such as their rearrangement into regular order under stress with its clearly defined metallurgical analogy. Among the latter were such tests as the reaction of different types of snow to varying meteorological conditions and the resulting tendency to increase or decrease avalanche danger. The drawing together of the many threads of research followed and the results, combined with the investigations of practical men in the mountains, have been of the greatest value in bringing about a closer understanding of, and so mitigating, avalanche dangers. An excellent publication of some 340 pages was produced in 1939 recounting the field and laboratory work up to the end of 1938, and subsequent publications have also appeared.

[1] From *Nature*.

Originally the governing body of the Weissfluhjoch station was the Swiss Commission for Snow and Avalanche Research under the chairmanship of the head of the Federal Forestry Department and working in conjunction with many Swiss men of science, chief of whom was Professor P. Niggli, the mineralogist, of Zurich, and including many experts in cognate subjects such as Dr. Mörikofer, of the Meteorological Observatory at Davos. It was largely financed from unofficial sources. A recent press notice stated that the Swiss Government has opened a new research institute on the Weissfluhjoch, which is assumed to be a development of the earlier laboratory, perhaps more on the lines of the research institute on the Jungfraujoch. Possibly it means the commencement of its existence as a separate department of the Ministry for the Interior, with more adequate funds for effective research than its semi-private forerunner had been able to command.

THE TROPICAL PLANT RESEARCH FOUNDATION

THE Board of Trustees of the Tropical Plant Research Foundation met in Washington, D. C., on May 21, for the purpose of dissolving the foundation and distributing its assets to other organizations that are now carrying forward the avowed functions of the foundation. They also authorized and directed the officers of the corporation to institute proceedings in the United States District Court of the District of Columbia for the dissolution of this corporation as allowed and provided for by law.

The distribution of assets were as follows: (1) The Tropical Agriculture Library now housed at the Boyce Thompson Institute, including all copyrights, was given to the Inter-American Institute of Agricultural Sciences of Turrialba, Costa Rica. This is to be dedicated and marked with an appropriate plaque as a memorial to Dr. W. A. Orton, the organizer and director and general manager of the foundation from its inception in 1924 until his death in 1930. (2) Fifty copies of "The Soils of Cuba," including the accompanying maps, were given to each of the joint authors, H. H. Bennett and Dr. R. V. Allison. Fifty copies of "Tropical Forests of the Caribbean" were given to the author, Tom Gill. The remaining copies of these books, about 550 of the former and about 225 of the latter, were turned over to the Pan American Union to be advertised and sold. The returns from these sales are to be turned over to the Division of Biology and Agriculture of the National Research Council or to some other appropriate organization to be used to further tropical agriculture. (3) All residual cash and bonds, after payment of debts and expenses of dissolution, were given to the Division of Biology and Agriculture of the National Research Council to be used for the promotion of tropical agriculture. This contribution will net about $4,500. (4) The furniture, bookcases, steel cabinets, etc., are left to the Boyce Thompson Institute for Plant Research, Inc., Yonkers, New York, in appreciation of services rendered the foundation during the period following Dr. Orton's death.

WILLIAM CROCKER,
Acting Director and General Manager,
Tropical Plant Research Foundation

THE INDUSTRIAL RESEARCH INSTITUTE

THE Industrial Research Institute completed five years of activity with its recent annual meeting in New York on May 21 and 22. Seventy industrial executives and research directors, representing member companies, and their guests attended the meeting and participated in informal round-table conferences.

The organization of research in Great Britain and the United States, its support of the war effort and probable post-war trends, was discussed at the dinner session on the evening of May 21. Dr. G. S. Whitby, professor of rubber chemistry at the University of Akron and recently director of the chemical research laboratory of the Department of Scientific and Industrial Research, Teddington, England, presented the British picture, and Dr. Robert W. King, assistant vice-president of the American Telephone and Telegraph Company, discussed the situation in this country. Dr. Whitby explained the basic differences in the organization and effectiveness of research in Britain and the United States.

At a session on new research tools Dr. G. W. King, of Arthur D. Little, Inc., discussed improved calculating machines for scientific use, particularly in the field of chemistry. Dr. W. B. Rayton, director of the Scientific Bureau of Bausch and Lomb Optical Company, described new optical tools and their applications in various fields of industrial research.

Other sessions were devoted to discussions of industrial research management problems. R. C. Benner, director of research, and G. J. Easter, assistant director of research of the Carborundum Company, described a simple system which has proved of great help in the current control of research projects. It is based on the budgeting of time rather than money. Cooperative intra-industry research in seventeen industries represented in the institute was reviewed by J. M. McIlvain, administrative supervisor of the Research and Development Department of the Atlantic Refining Company.

The rating of research personnel was discussed in four simultaneous group conferences on Saturday morning, under the leadership of C. L. Bausch, vice-

president, Bausch and Lomb Optical Company; J. N. Dow, technical director, Bigelow-Sanford Carpet Company, Thompsonville, Conn.; R. S. Taylor, chief engineer, Servel, Inc., Evansville, Ind.; and H. L. Trumbull, assistant to the director of research, the B. F. Goodrich Company, Akron, Ohio.

William R. Hainsworth, vice-president of Servel, Inc., New York, was elected chairman of the executive committee for the ensuing year, and Harold K. Work, manager of the Research and Development Division, General Metallurgical Department of the Jones and Laughlin Steel Corporation, Pittsburgh, was elected vice-chairman. Three new members of the committee were also elected for three-year terms: A. Griffin Ashcroft, product engineer of the Alexander Smith and Sons Carpet Company; Ralph T. K. Cornwell, director of research of the Sylvania Industrial Corporation, and John M. McIlvain. It was announced that the fall meeting of the institute will be held in Chicago.

The Industrial Research Institute, an affiliate of the National Research Council, undertakes to promote improvement of methods and more economical and effective management in industrial research through the cooperative efforts of its members. The membership is composed of fifty-five industrial concerns maintaining research laboratories. Their key executives in charge of research represent them in the activities of the institute. It has headquarters at 60 East 42nd Street, New York. Other members of the executive committee are: Harvey S. Benson, administrative engineer, United Shoe Machinery Corporation, Beverly, Mass.; Maurice Holland, member at large, Division of Engineering and Industrial Research, National Research Council, New York, and Philip W. Pillsbury, president, Pillsbury Flour Mills Company, Minneapolis.

THE MOBILIZATION OF SCIENCE

THE North Carolina Academy of Science has addressed the following letter to members of the United States Senate:

To the Members of the United States Senate

GENTLEMEN:

The North Carolina Academy of Science through its Legislative Committee wishes to call your attention to their action as regards the Senate Bill 702 "A bill to Mobilize the Scientific and Technical Resources of the Nation, to Establish an Office of Scientific and Technical Mobilization, and for Other Purposes."

This Bill would make another expensive and overlapping Office in the Federal Government. It would add confusion. It would not help in the War Effort. It would not help in the Peace to come.

Therefore be it Resolved:

That the North Carolina Academy goes on record as opposing the passage of Senate Bill 702 as said bill would serve no useful purpose.

Signed for the Academy by the Legislative Committee,

WILLARD BERRY, *Chairman*
B. C. BURGESS
H. F. PRYTHERCH
B. W. WELLS

ABBOTT LABORATORIES FELLOWSHIPS

ABBOTT LABORATORIES has announced that its plan of postgraduate fellowships for research in organic chemistry and in biochemistry will be continued for the academic year 1943–44. These fellowships are to aid capable graduate students in continuing their studies. There are no restrictions as to the professor under whom the work is to be done or the subject to be undertaken. The stipend is $750 per year. For the coming year the fellowships are available to both men and women.

The universities to whom these fellowships have been awarded are as follows:

In organic chemistry:
University of California
University of Illinois
University of Michigan
University of Minnesota
Purdue University
University of Rochester
Stanford University

In biochemistry:
Duke University
Iowa State College

It is believed that this aid for graduate study in chemistry will lend encouragement to the continuous training of able and qualified chemists to fill future positions in the educational field and in industry.

GRANT TO THE UNIVERSITY OF MICHIGAN FROM THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

THE National Foundation for Infantile Paralysis and the University of Michigan have joined in a long-range program for the training of doctors, public health workers and laboratory technicians to study infantile paralysis and other virus diseases. This program, which has been developing for three years, will be expanded when the university opens its new three-story building for the School of Public Health.

The new structure will house a unit devoted entirely to work in virus diseases, particularly infantile paralysis. The virologists who will be trained under the program will study all virus diseases, including not only infantile paralysis, but also influenza, atypical

pneumonias, St. Louis and equine encephalitis, measles, chickenpox, smallpox and mumps.

To aid in the necessary planning and execution of the project, the National Foundation has made a three-year grant, amounting to $120,000, to the university. This is in addition to three previous grants amounting to $110,000, made during the past three years. This makes $230,000, which the foundation has made available to the School of Public Health of the university since May 13, 1940, when the first steps in the program were planned by Basil O'Connor, director of the foundation, and Dr. Henry F. Vaughan, dean of the School of Public Health.

President Alexander G. Ruthven made a statement in which he pointed out that, even though the school has not had adequate facilities during the two years since it opened, it has made several outstanding contributions to our knowledge of how the disease is transmitted and on other epidemic diseases in the army and in vital war industries. In addition, twenty men and women have received training in virology during that period.

This is the first time in the history of the National Foundation that three long-term grants have been made within the space of a single year. In April a five-year grant of $150,000 was made to Yale University to permit it to reorganize its work on infantile paralysis and establish the Yale Poliomyelitis Study Unit. Last summer a five-year grant of $300,000 was made to the Johns Hopkins University to establish and conduct a Center for the Study of Infantile Paralysis and Related Virus Diseases.

HONORARY DOCTORATES CONFERRED BY COLUMBIA UNIVERSITY

THE doctorate of science was conferred by Columbia University on June 1 at its one hundred and eighty-ninth commencement on Dr. Charles F. Kettering, vice-president of the General Motors Corporation, and on John Van Nostrand Dorr, president of the Dorr Engineering Company. The doctorate of laws was conferred on William Church Osborn, president of the Metropolitan Museum of Art. The citations by President Nicholas Murray Butler read:

Charles Franklin Kettering: Who for some forty years as engineer and as inventor has contributed in many important ways to human comfort and human safety, particularly in the field of transportation; an outstanding representative of the applied science of our time.

John Van Nostrand Dorr: Graduated at Rutgers University, from which he entered upon a long and most useful career as engineer, inventor and administrator in the fields of metallurgical, sanitary and chemical engineering, with results which have been of exceptional service to the American people and their industries.

William Church Osborn: Graduated at Princeton University when it was under the historic presidency of Dr. McCosh, accepting at once the full responsibilities of good citizenship and continuing to serve the public interest year by year, well illustrating the saying of George Eliot that service done by willing and discerning souls is a glory; now president of the Metropolitan Museum of Art, one of the great art collections in this modern world.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM D. COOLIDGE, vice-president and director of research of the General Electric Company, has been awarded the "Order del Merito" of Chile for his "many services to civilization."

AT a recent meeting of the Royal College of Surgeons of England, the president, Sir Alfred Webb-Johnson, admitted two new honorary fellows, Colonel Elliott C. Cutler, Moseley professor of surgery at Harvard University and chief surgical consultant to the United States Army in the European theater of operations, and Professor W. G. Penfield, professor of neurology and neurosurgery at McGill University.

DR. OTIS W. CALDWELL, general secretary of the American Association for the Advancement of Science, who has been a member of the New York Botanical Garden since 1920, has been voted a life member by the executive committee of the Board of Managers in recognition "of his many services to botanical science and to this Botanical Garden over a long period of years."

THE American Association of Industrial Physicians and Surgeons has awarded the Wm. S. Knudsen Medal for "the most outstanding contribution of the year to industrial medicine" to Dr. William A. Sawyer, medical director of the Eastman Kodak Company. The award was made in recognition of his "work in control of tuberculosis, constructive contributions to a practical program of nutrition in industry and setting up a program of rehabilitation for handicapped workers in industry."

DR. CHARLES KENNETH LEITH, professor of geology at the University of Wisconsin, now head of the metals and minerals branch of Production Research and Development of the War Production Board, received the honorary degree of doctor of science at the commencement exercises of Stevens Institute. Dr. Leith gave the commencement address.

THE Medical School of Tufts College conferred at commencement the honorary degree of doctor of laws on Dr. Lewis H. Weed, professor of anatomy at the

Johns Hopkins University School of Medicine and chairman of the Division of Medical Sciences of the National Research Council. Dr. Weed delivered the convocation address. He spoke on "War Research in Medicine and Dentistry."

DEPAUW UNIVERSITY conferred at its commencement on May 16 the honorary doctorate of science on Dr. Harlan H. York, professor of botany at the University of Pennsylvania.

MAJOR GENERAL RALPH ROYCE, commander of the First Air Force, on June 5 received an honorary doctorate of engineering from the Michigan College of Mining and Technology.

AT the annual dinner meeting and ladies' night of the Branner Geological Society, which was held on May 26 at the California Institute of Technology, the following officers were elected for the coming season: *President,* Herschel Driver, of the Standard Oil Company of California; *Vice-president,* Robert W. Webb, of the department of geology of the University of California at Los Angeles; *Secretary-Treasurer,* Vincent W. Vandiver, of the Seaboard Oil Company. Retiring officers are Wayne Galliher, of the Barnsdall Oil Company; W. C. Putnam, of the department of geology, University of California at Los Angeles, and Clement D. Meserve, of the department of geology, Glendale Junior College. The speaker of the evening was Dr. Beno Gutenberg, professor of geophysics at the California Institute of Technology, who delivered an address on "The Structure of the Earth."

THE anniversary meeting of the members of the Royal Institution, London, was held on May 1 with Major Charles E. S. Phillips, secretary and vice-president, in the chair. The annual report of the visitors was received and adopted, and the following officers were elected: *President,* Lord Eustace Percy; *Treasurer,* Sir Robert Robertson; *Secretary,* Major Charles E. S. Phillips.

DR. S. L. MACINDOE has been elected president of the New South Wales Division of the Australian Association of Scientific Workers. F. Milthorpe is secretary of the division.

BRIGADIER GENERAL JAMES S. SIMMONS, chief of the Division of Preventive Medicine in the Office of the Surgeon General, has been appointed visiting lecturer in public health for the coming year by the School of Medicine of Yale University.

AT the Cornell University Medical College, Dr. McKeen Cattell, who has been a member of the staff since 1924, has been appointed professor of pharmacology and head of the department. Dr. John M. McLean has been promoted to a professorship of clinical surgery (ophthalmology).

DR. JOHN GODWIN DOWNING has been appointed professor of dermatology at the School of Medicine of Boston University and head of the department of dermatology.

DR. A. C. CHIBNALL, professor of biochemistry at the Imperial College of Science and Technology, South Kensington, has been elected to the Sir William Dunn professorship of biochemistry of the University of Cambridge in succession to Sir Frederick Gowland Hopkins.

DR. E. D. HUGHES, lecturer in chemistry at University College, London, has been appointed professor of chemistry at the University College of North Wales at Bangor.

DR. J. ALLEN SCOTT, associate director of the Division of Malaria and Hookworm Service of the Georgia Department of Public Health, has resigned to accept an appointment as senior statistician of the Division of Vital Statistics, U. S. Bureau of the Census, Washington, D. C.

DR. FREDERICK MACCURDY, professor of hospital administration at Columbia University and director of the Vanderbilt Clinic of the Columbia Presbyterian Medical Center, has been appointed New York State Commissioner of Mental Hygiene.

A. C. HOFFMAN, formerly agricultural economist of the U. S. Department of Agriculture and now director of the Food Price Division of the Office of Price Administration, has been appointed assistant to the Deputy Administrator for Price. He will be succeeded in his former post of director of the Food Price Division by R. B. Heflebower, who has served with the Office of Price Administration for approximately a year, first as state price officer for Idaho and more recently as special assistant to the deputy administrator on assignment to the Denver Regional Office.

DR. CARL A. FRISCHE has been named chief research director of the Sperry Gyroscope Company. He will assume charge of the laboratory at Garden City, L. I., which employs more than 1,500 technicians for the design, development and test of military, marine and aircraft precision instruments.

H. N. RILEY, director in charge of research and quality control of the H. J. Heinz Company of Pittsburgh, has been elected vice-president of the company.

DR. CHARLES HANES, F.R.S., has been appointed director of food investigation in the British Department of Scientific and Industrial Research.

DR. ARTHUR H. SMITH, of the department of physiological chemistry of Wayne University College of Medicine, gave the Sigma Xi address at the annual

initiation of the Chicago Colleges of the University of Illinois Chapter on May 21. The subject was "Nutrition—A Factor in National Effort."

DR. ALEXANDER SILVERMAN, head of the department of chemistry of the University of Pittsburgh, gave a radio broadcast on "Glass Goes to War" over Station WGY, Schenectady, N. Y., on June 9.

THE two hundred and fifty-fifth meeting of the American Physical Society will be held at State College, Pennsylvania, on June 18 and 19. There will be a symposium on "Physics in War Training Programs." At twelve noon a lecture on Cosmic Rays will be given by Professor W. F. G. Swann of the Bartol Foundation. At 2:30 P.M. there will be a symposium on "The Role of Physics in the Post-War Period." The program continues through Saturday with invited papers concerning Chemical Analysis by Physical Methods and with contributed papers. The American Association of Physics Teachers holds a meeting which begins with contributed papers on June 18 at 7:30, and continues throughout the following day. The dinner of the societies is set for Friday evening, and will be followed by a lecture by Dr. F. C. Whitmore on "Organic Chemistry for Physicists."

A MEETING was called by the Nutrition Foundation on May 27 in New York City to discuss normal ideas of food preservation and distribution which are being revolutionized by the war, and how the cooperation of food and research laboratories with specialists in nutrition is essential to meeting these new problems. Dr. Charles Glen King, scientific director of the Nutrition Foundation, presided at the meeting, at which sixty research and technical directors of food companies were present, as well as representatives of the government.

THE seventh annual Huntington College, Ind., Botanical Garden Day meeting was held early in May. The address for the occasion was given by Dr. Truman Yuncker, of the department of botany of DePauw University. He gave some of his botanical experiences in the South Sea Islands where he studied for a year. The Huntington College Botanical Garden is now in its eighth year and has six hundred and seventy-one living species all of which have been moved into the garden from various habitats in the central states.

THE late Edsel Bryant Ford, only son of Henry Ford, left the major part of his stockholdings in the Ford Motor Company to the Ford Foundation, incorporated in January, 1936, for the purpose of receiving and administering funds for "scientific, educational and charitable purposes, all for the public welfare." The value of the estate is estimated at $200,000,000.

THE library of the late Professor Franz Boas, a collection of nearly 5,000 volumes and 10,000 reprints, which is particularly rich in early works on anthropology, has been acquired by Northwestern University.

THE American Standards Association has announced the publication of its new "List of American Standards" which will serve as a useful reference to the engineering and purchasing departments of manufacturing firms. More than six hundred standards are listed, ninety-four of which represent new and revised standards approved since the last issue, which appeared in August, 1942.

QUARTZ crystals are needed by the Miscellaneous Minerals Division of the War Production Board for the manufacture of quartz oscillator plates used in radio equipment for the armed forces. At present practically all the quartz used for this purpose comes from Brazil. Only separate individual crystal-clusters are wanted. Each crystal must weigh at least half a pound, be at least an inch thick and three inches long. It must be clear and colorless on the inside, although light smoky quartz can be used. Milky quartz, rose quartz and purple quartz (amethyst) are useless. Citizens who may own property on which such material may be found are requested to get in touch with the Division, Temporary "R" Building, Washington, D. C. If samples can be provided at the same time, they will be welcome. There should be several samples of the best crystals obtainable from each location.

IT is reported that investigation on certain aspects of nutrition in Great Britain is at present handicapped by lack of cooperation. In view of the importance, at the present time, of a thorough knowledge of the state of nutrition in Great Britain, the Nutrition Society has accordingly set up a Committee on Nutrition Surveys, with Sir Joseph Barcroft as chairman; the terms of reference are the coordination of nutrition surveys dependent on (*a*) clinical, physiological and biochemical examinations of human subjects, (*b*) examinations of food budgets, and (*c*) chemical analyses of food and meals (including collective meals). The committee will put investigators in touch with others who are working on the same lines or would cooperate; it will supply information, recommend methods and make periodical summaries of the results of investigations. It has the support of the Ministries of Health and of Food and cooperation of the Services. Professor J. R. Marrack has been appointed as a director serving under the committee.

Nature writes: "Professor A. V. Hill, in a debate on Colonial affairs in the House of Commons, gave his powerful aid to recent pleas for the active support and cooperation of the universities of the British Empire in the advance of Colonial education. He recalls

the opportunity for their active participation in the training of the body of teachers and scientific and professional men that the Colonial peoples so greatly need, and must provide as rapidly as possible from their own ranks. He suggests not only taking a mission—with a harmonium rather than a big drum—around the universities to enlist their active contribution, but also the establishment of a central organization of some kind to watch over the needs of the higher education of Colonial peoples, and to bring their needs and the opportunities these offer continually to the notice of schools, universities and learned societies at home."

THE British National Trust has acquired nine hundred and fifty acres of land at Avebury for the nation. The purchase includes the greater part of the group of prehistoric remains that make this one of the most important archeological sites of Europe.

THE Library of Congress has acquired a microfilm of *Khimicheskii Referativnyi Zhurnal* (chemical abstracts journal) for the years 1938 to 1941 (Volumes 1–4, No. 9) except for No. 4, 1939, and No. 12, 1940. This publication contains abstracts of scientific material published exclusively in the U. S. S. R. The microfilm is available for consultation in the Microfilm Reading Room of the Library of Congress or positive prints may be obtained from the Library of Congress Photoduplication Service.

ACCORDING to a Reuter dispatch from London, Sir Isaac Newton's library has been sold to the Pilgrim Trust. The library consists of 858 volumes, nearly all in contemporary calf bindings. The most important items are first and second editions with many corrections in Newton's handwriting. A number of the books have Newton's autograph signature. The destination of this collection has not been announced. Some months ago the Pilgrim Trust bought the Newton birthplace for the nation.

DISCUSSION

SCIENCE AND WAR

IN SCIENCE (Vol. 97, p. 485), Professor R. A. Millikan attempts to refute the argument that the physical sciences are largely the offspring of war and in so doing makes statements to which scholars who have devoted their lives to the history of science and technology will probably object.

There is no acceptable proof that "gunpowder was invented and first used only for peaceful purposes about 880 A.D." Professor George Sarton has studied all the original sources of information and concluded that gunpowder first appeared toward the close of the thirteenth century either in Syria or western Europe. Moreover, it was used in incendiary and explosive hand grenades soon after its invention.

Professor Millikan maintains that the application of artillery "first began on a serious scale about 1800 A.D." Cannon and muskets were so effective by the sixteenth century that they were rapidly displacing the long bow and other feudal equipment. Sombart goes into this matter thoroughly in his "Krieg und Kapitalismus."

To insist that the discovery of the principles of Galilean-Newtonian mechanics "had nothing whatever to do with war" is to fly in the face of the facts. All the physicists of the Renaissance were inspired by military problems. Newton and Galileo were much concerned with ballistics. The historic evidence that both were strongly influenced by military and naval considerations has been gathered and weighed by B. Hessen in "Science at the Crossroads." His interpretation is widely accepted.

Professor Millikan's statement that science flowered with exceptional vigor from 1814 to 1914, one of the few relatively peaceful periods in European history, ignores the fact that every country was then preparing for possible war, that standing armies were increasing in numbers and that military and naval technology were brought almost to their present pitch of perfection. It was in this period of armed peace that we had such developments as battleship armor, built-up guns, machine-guns, high explosives, coal-tar chemistry (closely linked with explosives), the reduction of nitrogen from the atmosphere (for military purposes primarily), aviation (encouraged for military reasons by every power) and the beginning of synthetic rubber (developed by the Germans in view of an inevitable blockade).

In considering this period Professor Millikan ignores "derivative problems," as Professor Robert Merton calls them, that is, such problems as the expansion and compressibility of gases, strength of metals, rates of combustion of powders, resistance of the air to projectiles and a host of others which were presented by explosives and which received the attention of physicists to the advantage of both war and science. Professor Millikan seems to imply that because the research scientist may be unaware of social pressure he remains immune to it. But the pressure is there and can not be avoided.

It is difficult to see that Professor Millikan proves anything by saying that "the average span of life . . . is about sixty years, whereas only 150 years ago it was about thirty years." Soldiers benefit from advances

in medicine and sanitary organization as much as do civilians. A good deal of medicine and hygiene came out of war.

The relation of science to war is not easy to disentangle from a complex of factors, such as the downfall of feudalism, the Reformation, the rise of liberalism and democracy and hence of "high capitalism" and the trader. But the evidence collected by specialists indicates plainly the pressure that the exigencies of war have exerted upon physical scientists.

The effect of war on technology is especially clear. There is not the slightest doubt that the blast-furnace, the coke-oven, the steam-engine, machine-tools and the heavy chemical industry came directly out of military necessity with the introduction of firearms. Here the researches of such scholars as Merton and Werner Sombart are authoritative.

The branches of biology which have made most progress are agriculture and medicine, and the relation of both to war has been brought out time and time again. Moreover, it is significant that the biological sciences as a whole lag behind the physical sciences for the reason that military advantage and profits lie in chemistry, physics and engineering but not in the study of life.

Lastly, there is the remarkable fact that the Chinese, on the whole a stable and pacific people with a culture that has come down intact from ancient times, long made no military use of gunpowder, though they were familiar with it for centuries. As technicians and craftsmen they were in no way inferior to their European contemporaries until the arrival of the Jesuits. Much of the Taoist doctrine of non-action and non-violence must have sunk into the masses. It is significant that in Europe, where gunpowder was used in war, science leaped forward with the introduction of cannon, whereas in China, where gunpowder was used only in pyrotechnics, experimental science was not developed. At any rate it is clear that social influences can not be disregarded in tracing the history of science. And the social influences in Europe have always been chiefly military and economic, with war and economics evolving hand in hand.

WALDEMAR KAEMPFFERT

AREA FIGURES FOR UNITED STATES AND GREAT LAKES STATES

IT will be a surprise to practically every one to realize that the leading reference books of the world give the total area of the United States some 61,000 square miles less than it actually is; the State of Michigan some 40,000 square miles less; Wisconsin about 10,000 square miles less; with similar though lesser diminution of the total area figures for all the other Great Lakes States.

These errors are due to the practice of computing the total areas as if the northern boundary of the United States, which is also the northern boundary of each of the Great Lakes States, were the southern shoreline of the Great Lakes; whereas the international line through the Great Lakes region has nothing whatsoever to do with shore, channel or even presence of water, but is as definite and fixed in perpetuity as the 49th parallel.

Publishers of various reference books, when advised of these inaccuracies, reply that they are quoting the official figures of the U. S. Bureau of the Census.

The Bureau of the Census, in its area table, has an outright error in the total area of the United States. The same tabulation, by its misleading manner of presentation of the facts concerning the total areas of the Great Lakes States, has given rise and authority to the currently quoted total area figures for those states, which are incorrect.

Former Director Austin of the Census Bureau saw these mistakes—which have been of long standing—and agreed to correct the misleading method of presentation in the Census of 1940. After a change of directorship was made, the decision was reversed.

The Bureau of the Census refused to revise its manner of presentation (1) for its own statistical convenience; and (2) because it wishes not to arouse sea-coastal states which advance uncertain claims for strips of ocean water of varying width. For these two reasons it prefers to disregard the fact of absolute ownership by the United States and the Great Lakes States of the American portion of the Great Lakes, and continues to treat this part of the United States as if it were the high seas.

In final extenuation of their attitude, the Director of the Census has advised: "I call your attention to the fact that *land and water areas shown in Census publications have no legal status.* They are used by us solely for statistical purposes."

In direct contrast with the foregoing paragraph is the statement of the Librarian of Congress that the Bureau of the Census is the only authority at present for figures concerning the area of the United States and of the individual states.

The director of the American Geographical Society, speaking for himself, not in behalf of the society, agrees that from the jurisdictional point of view the waters of the Great Lakes within the international boundary should be considered as part of the United States, and their areas assigned to the several states of which they are a part, and that the Census Bureau would have done well to have made this clear.

Canada and Ontario find nothing to prevent the inclusion of their share of the Great Lakes in their total area figures.

Benjamin Franklin fought and defeated France, Spain and England, in Paris, in 1783, when they sought to set the limits of the United States at the southern shores of these bodies of water; but he has been thwarted now by a generation of statistical geographers in our own country who seem to consider the 60,000 square miles of American-owned Great Lakes water nothing but a general nuisance, who have discounted and discredited it, and even disregarded it completely.

This water right now is bearing the most important traffic in the world. Save for the iron ore which must pass over our Great Lakes, the Allied Nations could hold up their hands in complete surrender. Compare the value of this region—now excluded by arbitrary dictum from the total area figures of the Great Lakes States and the United States—with the hundreds of thousands of useless acres of land which are counted in the area of other states such as Texas.

The press of Michigan and Wisconsin has strongly advocated the correction. The best legal opinion in the country says that the case for the Great Lakes States is clearly proven and unanswerable. The Committee on Constitutional Revision in Michigan will include the accurate total area of Michigan in the new constitution of that state.

The Bureau of the Census can correct the situation in the world's reference books by a simple revision of its major area table. Sooner or later this will have to be done.

Meanwhile every one concerned with accurate knowledge rather than the exigencies of statistics will wish to correct his atlas as follows:

TOTAL AREA IN SQUARE MILES

Illinois	57,926	(land,	55,947;	water,	1,979)
Indiana	36,519	(land,	36,205;	water,	314)
Michigan	96,791	(land,	57,022;	water,	39,769)
Minnesota	86,280	(land,	80,009;	water,	6,271)
New York	53,203	(land,	47,929;	water,	5,274)
Ohio	44,679	(land,	41,122;	water,	3,557)
Pennsylvania	46,068	(land,	45,045;	water,	1,023)
Wisconsin	66,216	(land,	54,715;	water,	11,501)
UNITED STATES	3,082,809	(land,	2,977,128;	water,	105,681)

CHASE S. OSBORN
STELLANOVA OSBORN

SAULT STE. MARIE, MICH.

MISUSE OF THE TERMS "CLASS DISTINCTION" AND "DEMOCRACY"

PROFESSOR MAST'S letter on page 465 of the May 21, 1943, issue of SCIENCE misuses these two terms. Regardless of its validity, no recognition of outstanding ability can properly be called "class distinction." Certainly no one should think that a democracy implies a group of individuals either having absolutely uniform ability or a pretense at such uniform ability such as would be implied by the elimination of all marks of recognition for outstanding ability. A literal and logical acceptance of the plea to eliminate "starring" of names in the biographical directory of American Men of Science would mean the abolition of all honorary societies, all medals and awards, and, in fact, all recognition of outstanding ability and achievement.

The means by which "stars" are awarded in the various editions of the biographical directory may not be perfect, but it is probably the most "democratic" method by which any recognition of outstanding achievement may be determined.

As to a referendum on "starring" scientists, I would hazard the guess that while many of those with "stars" might vote against the system there would be an overwhelming majority in favor of the system from those not so "decorated."

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THE DISCOVERY OF "STARS"—A PRESENT PROBLEM

I HAVE been interested in the discussion of the "stars" in SCIENCE, believing that such discussion is wholesome. I have heard of Americans being called "dollar chasers" abroad, and I have seen "money grubbers" myself and I have assumed that a broader American culture would supply a wider variety of goals for man to strive for. Hence I have seen no harm in prizes, academic honorary degrees, societies with honorary memberships and even those with qualified membership, since they are supposedly awarded for personal merit. Every one will recognize that a quiet Willard Gibbs might in any generation be overlooked by an Academy of Sciences in its elections. Nevertheless, the peers of such a Willard Gibbs should be the best qualified to locate the "stars" of their generation.

It is of great benefit to the public that the star is located because (1), his productivity may thereby be enhanced, either by the encouragement or by increased facilities afforded; (2) his work may be more certainly preserved for posterity; (3) their results may be utilized, and his work used for the emulation of others.

It is not a question of personal vanity at all. It is not a matter of concern whether the ancestors of Gibbs came over on the *Mayflower* or were aborigines. It is rather what he did, how well we can use those results and what we can learn from his life. Mozart, Schubert and Poe were indeed stars, but it is difficult to believe that neglect on the part of the public of their period made them great. On the other hand, we instinctively feel that our neglect caused the loss of invaluable treasures of music and art.

It is a matter of merely enlightened self-interest for society to seek out a Wallace Carothers and afford him the most suitable surroundings for his genius to work in. How to do that is a problem that science may well ponder.

EUGENE C. BINGHAM

SCIENTIFIC BOOKS

VIRUS DISEASES

Virus Diseases. By Members of the Rockefeller Institute for Medical Research, THOMAS M. RIVERS, W. M. STANLEY, L. O. KUNKEL, R. E. SHOPE, F. L. HORSFALL, JR., PEYTON ROUS. Ithaca, N. Y.: Cornell University Press. 1943. $2.00.

THE title of the volume suggests a text-book. In the technical sense this is far from the case but, in content, a more illuminating insight into experimental thinking could scarcely be devised. The book comprises the Messenger Lectures on the Evolution of Civilization delivered by six members of the Rockefeller Institute at Cornell University in the spring of 1942, said lectures having "the special purpose of raising the moral standard of our political, business, and social life." Although each lecturer deals with specific aspects of the virus problem in which he has been engaged, the composite view is a varied approach to the broad biological problem of the nature of viruses and their modes of action.

In the first of the series, "Virus Diseases with Particular Reference to Vaccinia," T. M. Rivers reviews the concerted efforts to characterize vaccine virus by analysis of its antigenic, physical and chemical properties. Following the principles which have yielded such valuable information of bacterial action, the newer methods of immunochemistry, biochemical assay, enzymatic identification and physical measurements, have been employed by associates and collaborators of special skills with the result that many properties of vaccine virus in the form of elementary bodies have been determined. The manifold attack has revealed a multiplicity of antigens and the presence of chemical substances such as biotin and flavin which suggest the animate nature of the virus; it has also disclosed limitations in the interpretation of homogeneity on the basis of centrifugal or electrophoretic boundaries. The whole story is highly instructive and attractive reading.

Under the title of "Chemical Structure and the Mutation of Viruses," W. M. Stanley tells of the attempts in his laboratory to induce mutants or variants of tobacco mosaic virus by chemical alterations of the virus protein. Having determined that certain strains of the virus differed in their content of certain amino acids, it was suggested that the variations in behavior were related to these differences. Accordingly, virus chemically modified by extensive coverage of the amino and phenol groups was inoculated onto susceptible plants in the hope that the virus produced in the infected plant would resemble the modified material. This was not the case; the resultant virus was similar in nearly all respects to the usual tobacco mosaic virus; however, it was found that the virulence of the virus for a different host was decreased. Chemical treatment beyond a certain point destroyed activity. The studies represent the beginning of a stimulating approach to the fundamental problem of biological variation.

The need for transmission of the agent of an infectious disease of man to new hosts in order to study it adequately is obvious. It may come as a surprise to many that great advantages accrue to the same procedure in the investigation of virus diseases of plants. L. O. Kunkel in the lecture, "New Hosts as a Key to Progress in Plant Virus Disease Research," gives numerous examples of the benefits to be gained: the recognition of unsuspected mixed infections, the attenuation or exaltation of a virus, the appearance of otherwise unexpected properties, and the transfer to new hosts by way of an intermediate plant host, are some of them. The latter procedure has recently proved a notable success in the transfer of viruses which previously had been transmissible only by grafting. The lecture contains numerous implications of importance to the entire field of infection and adaptation.

The attention of investigators of virus diseases has been constantly attracted to Shope's studies of swine influenza. The first part of the present lecture is devoted to reviewing the history and earlier studies leading to the identification of the complex virus-bacterial nature of the disease. The remainder deals with the problem of the origin of epizootics and the residence of the virus in interepizootic periods. A summary is given of the evidence that the virus in masked form is maintained in the lung worms from infected hogs through their developmental cycle in the intermediate earthworm host and back to residence in the lungs of normal swine where proper stimuli serve to activate the virus and incite infection of the animal. The thesis clearly provides a reservoir and an explanation for the sudden reappearance of the disease in wide areas after many months of absence. The analogies and implications for human disease are discussed. In this instance again, the ingenious and skilful experimentation of the investigator are disclosed in relation to a concept, the significance of which extends beyond the biological confines of the disease primarily discussed.

In his discussion of "Human Influenza," F. L. Horsfall, Jr., considers the problem in its broad clinical sense of a symptom-complex which may be of divergent etiology and identified in terms of its distribution as pandemic, epidemic or endemic influenza. The major portion of the discussion deals with the epidemic disease, the etiology of which has been recognized in recent years. An extremely valuable review of the widespread studies is made, especially those concerned with the factors influencing resistance and the efforts toward prophylactic vaccination in which the author has been particularly interested. Critical evaluation is given of certain debated but hypothetical points. This lecture necessarily differs from others of the series in that it is concerned with the broad problem of a disease rather than detailed consideration of specific mechanisms.

The final lecture of the series, "Viruses and Tumors," is by Peyton Rous. In this, for the first time, he summarizes his views on mammalian tumors derived under a variety of influences. The clarification of the differences between the effects of viruses and chemical carcinogens is especially valuable, pointing out the *actuating* effect of the viruses in that each induces a specific type of tumor, whereas, the type of tumor evoked by the carcinogens is primarily dependent upon the natural tendencies of the host and the nature of the tissue to which the material is introduced. Further, the relation of viruses to chemical tumors, to the milk influence and to cancerous changes is presented. It is an important consideration of numerous aspects of a highly controversial subject, dealing as the author does with the biological mechanisms involved. Undoubtedly dissenting views will be expressed.

In conclusion, the purpose of this review has not been to find fault. Blunt criticism can be made of nearly any lecture for the absence of proof for ideas or the lack of interpretation of other data. Nevertheless, the purposes of a lecture are to present a point of view, correlative information and interpretations in an interesting manner. The present volume fulfills these functions to such an extent that it is highly recommended as provocative reading to biological investigators at large.

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STELLAR SPECTRA

An Atlas of Stellar Spectra with an Outline of Spectral Classification. By W. W. MORGAN, PHILIP C. KEENAN and EDITH KELLMAN. Chicago: The University of Chicago Press. 35 pp. 2 figs. 55 photographic reproductions. 1943. $10.00.

THE "Atlas of Stellar Spectra," by Morgan, Keenan and Kellman, has for some time been awaited with keen anticipation by astronomers engaged in the practical problems of spectral classification and the determination of absolute magnitudes. At first sight it seemed rather disappointing that the text accompanying the beautiful atlas should be limited to a descriptive outline of the classification system, without any discussion of the diverse criteria employed elsewhere; and without any analysis of the astrophysical implications. An examination of the contents, however, proves the wisdom of the omissions. Such detours might incite astrophysical discussion more than the practical application which is the unique primary purpose of the Atlas.

The objective of the work has been to set up a system of classification that would be as precise as possible and that could be applied to stars of the eighth to tenth magnitudes with good systematic accuracy. This objective required a two-dimensional system: the usual coordinate correlated with temperature and the new coordinate representing the absolute luminosity. The luminosity classification introduced (in terms of groups Ia, Ib, II–V) is as arbitrary as the usual spectroscopic classification: the luminosity is simply implied in this case, as temperature was implied in the other. The procedure of classification suggested is (1) the determination of an approximate spectral class (in the usual sense); (2) determination of the luminosity class, and (3) the derivation of a more accurate spectral class by comparison with a sequence of stars in the same luminosity class. Here the emphasis is somewhat different from that ordinarily encountered: we have been accustomed to hearing astronomers call for more accurate spectral classes in order that the subsequently determined absolute magnitudes might be more accurate; here, on the other hand, the luminosity classes are necessary in order to improve the spectral classes themselves. The two problems, of course, can not be solved independently, since all the spectral lines vary to some extent both with temperature and luminosity. Thus a few successive approximations are needed for their satisfactory solution.

The Atlas itself, consisting of 55 superb photographic reproductions of Yerkes spectrograms, is an exemplification of a purpose well achieved. First, sequences of spectra illustrate the fundamental progression of spectral class for stars of the main sequence. Then, for stars of the same spectral class, the variations with luminosity are illustrated. Finally groups showing the variation of spectral class among stars of various other luminosity groups (*e.g.*, giant or supergiant) are added. Although emphasis is placed on the more common classes of stars—one of the major purposes of the proposed system of classifi-

cation being its application to the statistical discussion of the distributions of stars—many peculiar objects are also illustrated and briefly discussed. Thus the entire array of prints is well selected to cover the great majority of problems and obstacles that the student of stellar classification is apt to encounter.

In general the criteria adopted by the authors are qualitatively in accord with the criteria Miss Annie J. Cannon employed for the massive Henry Draper Catalogue. Often the actual lines used in the two instances differ, while the elements represented are the same. There are, however, some marked discrepancies, the most conspicuous being in the utilization of the K-line of ionized calcium, which played a heavy role in all Miss Cannon's work but is not employed at all in Morgan, Keenan and Kellman's Atlas. Stars (mainly of the A and early F-types) classified on the new system will consequently show conspicuous systematic deviations from the Henry Draper system. This problem of the classification of the A- and F-type stars has arisen often before in this field of investigation. The criteria used for these classes at Mount Wilson and at Harvard, for example, have been conspicuously discordant, the Mount Wilson observers preferring to base their estimates on comparatively faint metallic lines rather than on the strong calcium line. The problem arose in the first place apparently because the K-line was ill placed at the weak violet extremity of the Mount Wilson spectra, whereas the fainter lines used at Mount Wilson do not show up well on the extremely small dispersion employed for the bulk of the Henry Draper Catalogue. Morgan's Yerkes spectra appear to represent a spectral purity in between the other two, and hence have the practical advantage of effecting a compromise between the faint apparent magnitudes accessible with the Harvard small dispersion objective prism spectra, and the detail and accuracy obtainable from the Mount Wilson equipment.

The descriptions of the various peculiar groups of A–F stars will unquestionably be helpful to other investigators. These stars can be arranged not only according to the temperature and luminosity classes; but numerous sub-groups exist which, from the abnormal intensities of certain lines, have been called silicon, strontium, manganese or metallic-line stars. To the last group, particularly, belong the problematic stars that are assigned to appreciably different classes when different criteria are employed. During work in progress by the reviewer, on the sub-classification of bright stars, two spectral classes are now being recorded for such stars. In extreme cases the discrepancy may amount to a whole spectral class. Although the proportion of stars with ambiguous spectral classes is small, the actual number is evidently too great to be ignored in problems of classification. Earlier work by Dr. Morgan paid much attention to the A stars, and his judgment on which criteria are most suitable, *i.e.,* best correlated with temperature, should be given high weight.

The authors stress the fact that the Atlas has been constructed from slit spectra having a dispersion of about 125 Ångstroms per millimeter. (The reproductions have been enlarged to about 8Å/mm). Just which criteria are most desirable and adequate for the determination of systematically accurate spectral classes depends very appreciably on the dispersion and purity of the spectrograms obtained. Very many of the criteria adopted at Victoria or Mount Wilson, for example, are unsuited to the small dispersion Yerkes spectrograms. Several of the spectral lines included among the Yerkes criteria, on the other hand, are too weak for the smaller dispersion objective prism spectra that Miss Cannon had used. Many of the Yerkes criteria outlined and illustrated appear admirable for the much larger-dispersion objective prism spectra (45Å/mm) used in similar work by the reviewer. Others of the Yerkes criteria, however, are not suited to these larger-scale photographs, because the pairs of lines easily compared in small dispersion are too far separated or situated where background differences in photographic density make intercomparisons awkward. Numerous instruments throughout the country (including those at Harvard) are, however, equipped to yield spectra for which the criteria given in the Atlas are admirably suited.

It is a pleasure to know that this much-needed guide to two-dimensional spectral classification is now available, and to recommend it not only to those who will use it as a research tool, but likewise to teachers who frequently need first-rate illustrations of typical spectra and of absolute magnitude effects. Moreover, the Atlas should go far toward bringing about a desirable greater uniformity in stellar classification in the future.

DORRIT HOFFLEIT

SPECIAL ARTICLES

OBSERVATIONS ON THE NATURE AND PROPERTIES OF THE FLUORESCENT FACTOR F_2[1]

THE accompanying publication of Huff and Perlzweig[2,3] prompts us to make the present report.

[1] From the Department of Pediatrics of the Johns Hopkins University and the Harriet Lane Home of the Johns Hopkins Hospital, Baltimore, Maryland.

[2] J. W. Huff and W. A. Perlzweig, SCIENCE, 97: 538, 1943.

Purified preparations of F_2 more than 100 times as potent in fluorescent units as the original permutit eluates[4] have been obtained from human urine by procedures to be published shortly. The final product is a waxy yellowish brown solid which has been crystallized. It is free from niacin, as judged by a negative immediate cyanogen bromide reaction, but possesses biological properties similar to niacin. One hamster rendered moribund on a niacin-free diet was restored to normal behavior within two hours after oral administration of purified F_2. Purified F_2 is a powerful bacterial growth catalyst for *E. coli* and *H. influenzae*.[5] F_2 occurs in the urine of animals that do not require niacin in their diet (pigs; rats); it occurs in many rat tissues, notably in the liver.

Purified F_2 is readily extracted by butyl alcohols only from alkaline solutions, which explains our observation[6] that alkalinization of urinary eluates was necessary before butyl alcohol extraction to obtain F_2 fluorescence. In acid, neutral or weakly alkaline solutions F_2 exhibits its characteristic fluorescence[7]; with strong alkali fluorescence becomes more greenish. This change is reversible on the addition of acid. On standing with alkali fluorescence gradually fades and a yellowish color develops, changes which are irreversible. F_2 oxidizes slowly in the air, more rapidly in the presence of alkali and $K_3Fe(CN)_6$; the characteristic blue fluorescence is lost and a violet fluorescence develops. This change is irreversible. Addition of acetone to alkaline F_2 solutions produces an intense yellow solution with a green fluorescence resembling that of uranium glass; this change is irreversible. Sulfanilic acid produces an orange red color with loss of fluorescence.

F_2 appears to be a pyridine compound. On alkaline hydrolysis a positive cyanogen bromide test[8] is obtained, not present originally. F_2 is destroyed rapidly by HNO_2.

Since our original communication[4] we have investigated various other pyridine derivatives and wish to report that none of the following can be identified with F_2: cozymase, dihydrocozymase, desaminocozymase, nicotinamide nucleoside and acetyl nicotinamide. We have for some time been familiar with the physical and chemical similarity between F_2 and the N-methyl reduction products of nicotinamide studied by Karrer *et al.*,[9] and had embarked on a program of preparing and testing these compounds when the communication of Huff and Perlzweig was sent to us. Our results to date indicate that one of the dihydro-N-methyl nicotinamides is indistinguishable from F_2 by its adsorption properties, solubility in eleven organic solvents and its reactions with alkali, $K_3Fe(CN)_6$, HNO_2, acetone and sulfanilic acid. We do not feel justified in identifying F_2 as an N-methyl dihydronicotinamide for three reasons: (1) because one of the N-ethyl isomers likewise possesses these identical properties; (2) because acetylation of F_2, of N-methyl and of N-ethyl dihydronicotinamide gives compounds with different fluorescent properties and solubilities; and (3) because the absorption spectrum of F_2 shows characteristic differences.[10]

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L. EMMETT HOLT, JR.

[3] Kindly shown to us in manuscript.

[4] V. A. Najjar and R. W. Wood, *Proc. Soc. Exp. Biol. and Med.*, 44: 386, 1940.

[5] These observations were made in collaboration with J. H. Hill and H. D. Zepp.

[6] V. A. Najjar and L. E. Holt, Jr., SCIENCE, 93: 20, 1941.

[7] V. A. Najjar, H. J. Stein, L. E. Holt, Jr., and C. V. Kabler, *J. Clin. Invest.*, 21: 263, 1942.

[8] We are indebted to Dr. Harold J. Stein for these determinations.

[9] P. Karrer, G. Schwartzenbach, F. Benz and U. Sollmsen, *Helvet. Chim. Acta*, 19: 811, 1936.

[10] We are indebted to Dr. N. H. Coy for these measurements.

THE PROBABLE IDENTITY OF NAJJAR AND HOLT'S FLUORESCENT SUBSTANCE, F_2

THE following observations are presented to show the similarity in biological and chemical behavior of N-methyl nicotinamide and F_2, the substance described by Najjar and collaborators,[1,2] as appearing in the urine in small amounts normally, and in large amounts after the ingestion of nicotinic acid derivatives.

N-methyl nicotinamide chloride, Fig. 1, was prepared essentially by the simple method given by Karrer.[3] A concentrated solution of F_2 in 25 per cent. KCl solution was prepared from urine obtained from human subjects after large doses of nicotinamide, by the original methods[1,2] and slightly modified by us. A comparison of the biological and chemical behavior of the two substances follows:

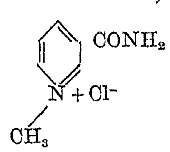

FIG. 1

Animal species which are known to methylate nicotinic acid, man, dog, rat, excreted F_2 in large amounts after doses of nicotinamide. In the rat, which synthesizes nicotinic acid and excretes it largely as tri-

[1] V. A. Najjar and R. W. Wood, *Proc. Soc. Exp. Biol. and Med.*, 44: 386, 1940.

[2] V. A. Najjar and L. E. Holt, SCIENCE, 93: 20, 1941.

[3] P. Karrer, G. Schwartzenbach, F. Benz and U. Sollmsen, *Helv. Chim. Acta.*, 19: 826, 1936. See also O. Warburg and W. Christian, *Biochem. Zeits.*, 287: pp. 314 ff, 1936, for an important discussion of N-methyl nicotinamide as a model for the active component of the reversibly reducible pyridine coenzymes.

gonelline,[4] we found that on a nicotinic acid-free diet F_2 excretion parallels closely the excretion of trigonelline (Table I). Removal of protein from the diet caused a sharp drop in the excretion of both F_2 and trigonelline. The rabbit, which is known not to methylate nicotinic acid to trigonelline,[5] excretes no F_2 after a dose of 250 mg of nicotinamide.

TABLE I

TRIGONELLINE AND F_2 EXCRETION IN RATS

Rat	*Trigonelline* /day	F_2 Units per day	*Diet*
1	97	32	23 per cent. protein
2	148	136	23 per cent. protein
3	227	288	23 per cent. protein
	31	66	Protein free
4	433	695	23 per cent. protein
	100	201	Protein free

N-methyl nicotinamide and F_2 were found to be adsorbed on and eluted from permutit under the same conditions from urine, and from pure solutions.

Both are extractable by butanol from alkaline KCl solutions and not from neutral or acid solutions. The fluorescence intensity of both is much greater in butanol than in aqueous KCl solution. Colorless aqueous solutions of both, when treated with dilute KOH at ordinary temperatures, become yellow and are reversibly decolorized on acidification. Butanol extracts of the yellow alkaline solution, under a Wood screened ultraviolet light, show green fluorescence which changes reversibly to blue on acidification. The above green fluorescence increases to a maximum in about 20 minutes. Both substances when heated with strong alkali also yield yellow solutions which are not decolorized on acidification. Butanol extracts of these yellow alkaline solutions show blue fluorescence which disappears on acidification and is restored on alkalinization. Hydrolysis of both substances in dilute aqueous HCl or KOH results in a greatly decreased fluorescence in their butanol extracts. This type of hydrolysis is known to convert the amide to the acid, or the N-methyl nicotinamide to trigonelline. Trigonelline also shows a very weak fluorescence under the above conditions.

Since the usual procedure for estimating trigonelline in urine[6] involves its hydrolysis to nicotinic acid with strong alkali in presence of ammonia (or urea), and since this treatment also converts both F_2 and the methyl nicotinamide to nicotinic acid, it is obvious that the previously published values for trigonelline in urine include substance F_2 in addition to true trigonelline.

Thus a normal adult who ingested 200 mg of N-methyl nicotinamide excreted in the urine in 48 hours F_2 equivalent to 55 mg of the original compound, as measured by its fluorescence, plus 85 mg of trigonelline.

From the urine of a normal adult, excreted in 20 hours after the ingestion of 750 mg of nicotinamide, we isolated a crystalline product as the picrate salt. The melting point of this product was 189.5° C (uncorr.) as compared with the melting point of the picrate of synthetic methyl nicotinamide which was identical, 189.5°, and the mixed melting point was unchanged. The picrates of the natural and of the synthetic products decomposed in dilute acid and after removal of the picric acid with ether, yielded quantitatively the identical amount of fluorescence in the ultraviolet, when measured in the usual way for F_2.

F_2 thus appears to be a N-methyl nicotinamide or a labile precursor which yields this compound in the course of isolation. Further work on the chemical identification of this compound and on its metabolic behavior is in progress.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

POLYVINYL ALCOHOL: A MEDIUM FOR MOUNTING AND CLEARING BIOLOGICAL SPECIMENS[1]

LUBKIN and Carsten[2] have recently reported on the use of polyvinyl alcohol, or PVA, in a method for the elimination of dehydration in histological technique. It is the purpose of the present note to report the use of PVA as a medium for the mounting and clearing of biological specimens.

PVA, a synthetic polymer of vinyl alcohol, is available through the E. I. du Pont de Nemours Company, R. & H. Chemical Department, Niagara Falls, New York. It may be purchased at low cost (less than $1.00 a pound) in pound lots or more.

[4] Jesse W. Huff and W. A. Perlzweig, *Jour. Biol. Chem.*, 142: No 1, 401, January, 1942.

[5] Y. Komori and Y. Sendju, *Jour. Biochem.*, 6: 163, 1926.

[1] The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of The Rockefeller Foundation.

[2] SCIENCE, 95: 633, 1942.

[6] William A. Perlzweig, Edward D. Levy and Herbert P. Sarett, *Jour. Biol. Chem.*, 136: No. 3, 729, December, 1940.

[7] Nutrition Foundation fellow. This study was also aided in part by grants from the John and Mary R. Markle Foundation and the Duke University Research Council.

The substance is obtained either as a light white powder or as amorphous granular material. It is soluble or dispersible in water, making a clear solution, syrupy in consistency. The viscosity of this solution can be varied by the amount of material added. PVA is not soluble in any of the ordinary fat solvents. The watery solution, upon drying, leaves a transparent, tough, thin film which adheres closely to a grease-free surface. This film is resistant to dampness, water (except immersion for a period of several hours), alcohol, ether, xylol, acetone and other solvents.

The stock solution is prepared by adding PVA (Grade RH-349) powder slowly to cold water, stirring it in thoroughly. The powder goes into solution with difficulty, but the process can be hastened by heating in a steam bath until the solution becomes about as viscous as thick molasses. At this time the solution appears milky, owing to the inclusion of small air bubbles. Upon further heating, or if left to stand for several hours, it becomes water clear. Any undissolved material can be strained off. The stock can be stored and preserved indefinitely and diluted with water to any consistency desired.

Several uses have been found for this stock solution. Giemsa stained blood films, both thin blood films and thick drops, have been preserved by spreading a thin film of stock solution over the stained portion and drying this quickly. Slight fading takes place before the solution dries completely, but after it has dried, such slides, placed even in direct sunlight or under ultra-violet lamp, will not lose any further color. The blood films are covered by a tough, thick film and after examination with oil the oil can be wiped off with a cloth with no possibility of damaging the smear. Slides examined two years after preservation by this method are still in excellent condition.

The stock solution has also been found useful for the examination of mosquito larvae. Live larvae are placed on two or three drops upon a slide. The larvae are quite firmly held by the viscous solution and can be examined most minutely for as long as half an hour. Upon completion of examination the larvae can be washed off into a container of water and soon recover. Smaller living organisms such as trematode cercariae may be placed in a drop of the solution and covered with a cover glass, following which they can be examined under oil immersion for twenty or thirty minutes before they die. This method also works well for detailed examination of motile microorganisms.

A clearing and mounting medium has been prepared by a modification of the original lacto-phenol medium which has the composition of glycerine 60 per cent., phenol 20 per cent., lactic acid 20 per cent. by volume. The original medium clears certain types of material satisfactorily but remains liquid and has to be sealed in, a very time-consuming procedure. We have prepared a somewhat similar preparation which we call polyvinyl-lacto-phenol: PVA stock solution 56 per cent., phenol 22 per cent., lactic acid 22 per cent. by volume. The resulting medium readily clears small objects removed directly from aqueous solution. Mosquito larvae can be satisfactorily mounted by dropping live larvae on to slides, draining off the water, adding 4 to 6 drops of PVA lacto-phenol and covering with a cover glass. More mounting medium should be added if necessary, so that a small amount of the medium flows out on all sides of the cover slip. In two days the cover slip will be cemented firmly in place and the larvae well cleared. In some cases it is necessary to add more medium later if it recedes under the cover slip while drying. Such mounts preserve all details necessary for identification.

A very satisfactory technique has been worked out for the mounting of the terminalia of male mosquitoes. The terminalia, after being cleared in 10 per cent. potassium hydroxide and stained with acid fuchsin, are dissected in a drop of PVA lacto-phenol. The viscosity of the solution aids dissection. The dissected parts can be transferred to a very small drop of solution on a clean slide and arranged as desired. The slide can then be dried in an incubator or on a hot plate so that the parts are firmly held in place in the dried film. A drop of mounting medium is then placed on a cover slip and the preparation covered. This method is rapid and simple.

The method also offers a quick and satisfactory means of mounting pollen grains for measurement and detailed examination and gives a permanent mount.

I should like to thank the E. I. du Pont de Nemours Company for the supply of PVA used and for information about its properties.

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SCIENCE NEWS

Science Service, Washington, D. C.

MULTIPLE STARS

Quadruplets and quintuplets in the sky may not be as rare as they are on the earth, but astronomers get nearly as excited about them. At the Cambridge meeting of the American Astronomical Society several papers dealt with multiple stars, among them a discussion by Mrs. Elizabeth Cornwall Tilley, of the University of Michigan, concerning the plain-seeming star known as 59D Serpentis.

Should 59D Serpentis be called single, as it appears to the naked eye? Or double, as it appears in a four-inch telescope? Or triple, as the spectroscope reveals one of its components to be? Or quadruple, as the sum of its parts would make it? But if quadruple is correct, the quads are not as nearly alike as they usually are among humans.

The star 59D Serpentis is also unusual in that two of its triplet stars are hot, white twins, while one is a cooler yellow star like our sun, only much larger.

One of the standard means for discovering doubleness among stars is to observe their spectra. If two stars are revolving around each other, some of their motion is probably toward and away from us, producing the well-known Doppler shift in their spectra. As one star approaches us along one side of the orbit, its spectrum is shifted toward the violet, while its companion's is shifted toward the red as that star recedes. Thus, two spectra are really being seen, and the lines in the combined spectrum appear double. These double lines gradually blend as the stars proceed along their orbits, then separate again. This is repeated twice for each revolution they make.

Sometimes one star is so much brighter than the other that the second star's spectrum is suppressed and only one set of lines is seen. However, the regular oscillation of these lines around a mean position proves the star to be a spectroscopic double in any case. In only two or three cases, including 59D Serpentis, are three spectra visible, and only for 59D have the details of the system been determined. The white twins revolve around each other once every 1.85 days, at a distance apart of only four million miles. Together, they revolve around the large yellow star, about 180 million miles distant, or the distance across the earth's orbit, in 386 days. These three form the triplet, around which the distant visual companion, also a white star, may require several thousand years to revolve.

The triple spectrum of 59D Serpentis was discovered independently in 1938 by McLaughlin at the University of Michigan and Tremblot in Paris, and in some cases they took spectrum photographs of the star on the same nights.—Charles A. Federer, Jr.

MONAZITE SANDS

There are many important uses of the rare-earth metals, and their compounds, obtained from the honey-yellow colored monazite. The principal metals obtained are cerium and thorium. Minor metals obtained include lanthanum, erbium, didymium, beryllium, and others of little or no commercial value.

Lanthanum salts are used in beauty preparations because they give bactericidal action. Erbium salts are astringents. Didymium is used in optical glasses because it protects the eyes from harmful rays. Cerium and thorium are the two elements in monazite which, either in their metallic forms or in compounds, fill essential war needs.

Cerium compounds have many important uses. Cerium acetate protects textiles from mildew and moths, and makes the textiles waterproof. Cerium fluoride mixed with carbon gives arc-lights and searchlights greater luminosity. Cerium oxide is used in ceramics and in the glass industry. The nitrate serves a special function in the gas mantle and also in tanning leather.

Thorium products are equally essential. Metallic thorium or thorium compounds are used in tungsten-lamp filaments, gas mantles, high-temperature refractories, radio-tube filaments, and for other purposes including several in the field of electronics.

Monazite sand is the only commercial source of cerium and thorium, according to the U. S. Bureau of Mines. Our supply, nearly 3,000 tons a year, has come from British India and Brazil. Transportation difficulties have now arisen. The India supply is no longer available.

Monazite sands are found in several places in the United States, but there has been very little domestic production recently because economic operations were not possible when cheaper foreign sands were available. Until 1909 domestic production met American needs. In the war years, 1915–17, the United States relied mainly on home production. From now until the war is over Brazil will be the principal source, unless richer deposits than now known are found in the United States.

NEW DISEASE IN THE ARMY

A mysterious disease for which no cause or method of getting it has yet been found turned up in some of the soldiers at Fort Bragg, N. C., late last summer, according to a report published in the *Journal* of the American Medical Association from Lieutenant Colonel Worth B. Daniels and Captain H. Arthur Grennan, two former Washington, D. C., physicians now in the Medical Corps, Army of the United States. They call the disease "Pretibial Fever."

Fortunately the disease was mild. There were no deaths and only forty cases. Because the men all were quartered near one another in a limited area of the reservation and had identical symptoms, it looked as if an epidemic of some sort were brewing.

Chief features of the sickness were fever, lasting about five days, and a rash, which appeared toward the end of the fever and was usually located over the inner, larger bone of the leg below the knee. This bone is the tibia, from which the disease gets its name, pretibial fever. As soon as the fever went down, the men got well rapidly, with no complications, weakness or depression.

A commission of experts assigned by the Surgeon General of the Army to investigate the disease was unable to find any germ cause or any method by which the men might have gotten it. Members of the commission were: Dr. John R. Paul, of Yale University Medical School; Dr. Norman H. Topping, U. S. Public Health Service, and Major Cornelius Philip, of the Army.

An outbreak of what may have been the same disease occurred in August, 1940, in Wrens, Ga.

SEPARATING WET FROM DRY GRAIN

AN ingenious method of separating wet from dry grain by use of an electrical condenser has been developed in England. T. A. Oxley, of the Department of Scientific and Industrial Research, and F. Y. Henderson, of the Imperial College of Science and Technology, have presented a method which may prove invaluable in preventing loss of grain through spoiling.

In both England and America large quantities of wheat are lost each year because of the development of fungi in the stored wheat. The fungi start in a moist, warm spot, often buried deep within the grain. It may either spread from there through the rest of the grain, or one such highly developed spot may be sufficient to taint the entire supply and make it unfit for milling. In order to preserve the crop, it is important to eliminate these wet danger spots. To do this by thoroughly drying the entire supply would be very expensive and in many cases impractical.

The more water in the grain, the poorer is electrical conductivity of the mass. As reported in *Nature,* use was made of this fact by passing the grain in a steady stream of uniform thickness between two metal plates acting as a condenser. If the grain is comparatively dry, it is sent down one chute. When the moisture reaches a certain percentage, the decreased electrical current causes a mechanism to divert the stream to another chute. Eventually, when the grain passing through becomes drier, it is automatically switched back to the first chute.

The moist grain is given priority in being dried. Not the entire harvest, but only the damper portions need be heated enough to eliminate the few highly moist spots. With the danger spots removed, all the grain can be safely stored until needed.

A NEW OPTICAL GLASS

BETTER cameras, spectacles and microscopes can be expected from use of a new lens glass developed after ten years' research, is announced by Dr. E. D. Tillyer, research director of the American Optical Company.

Sand, the principal ingredient of ordinary glass, is left out completely. According to Dr. Tillyer, omission of sand is the main reason for the superior optical properties of the new glass. Several common chemicals make up the formula of the new glass: boric acid, zinc oxide and aluminum hydroxide.

Another glass of the same type, but having different properties, is obtained by substituting cadmium oxide for the zinc oxide. This is the first time that the chemical element cadmium has been used as a major ingredient in glass.

In comparison with glass containing sand, the new glasses have higher light-bending power and less tendency to separate light into different colored rays, giving the often-observed rainbow effect. Although glass without sand is not new, these are evidently the first reports of such optical glass which shows commercial possibilities.

The new glass containing zinc oxide was developed by Dr. Tillyer, H. R. Moulton and T. M. Gunn. Mr. Moulton devised the kind containing cadmium. The product is still in a laboratory state of development and will not be available for some time.

ITEMS

A LARGE new double star has been discovered by Dr. J. A. Pearce, director of the Dominion Astrophysical Observatory, at Victoria, B. C. It is the spectroscopic binary, HD 34333, an eighth magnitude star in Auriga. Each part of this new system is a star having 23 times the mass of the sun and revolving around the other in slightly over 4 days, according to a report made by Dr. Pearce to the American Astronomical Society. Its orbital velocity is about 150 miles per second, and as one star passes between us and the other, it may produce a very slight partial eclipse, which Dr. Pearce predicts, but which has yet to be observed. Probably the light changes are small, but it is suggested that accurate observations of the star's light to see if there occur any periodic variations which would be caused by such eclipses. The present distance estimate places the system 3500 light-years from the sun.

PANCAKE diesel engines now powering Navy ships weigh less than a fourth as much as previous marine diesels of comparable power. They put out a horsepower for every four pounds of weight. Details of this new compact engine which occupies only a third the space of more conventional power plants was described at the Cleveland meeting of the Society of Automotive Engineers by J. C. Fetters, of the electro-motive division of General Motors Corporation. The nickname "pancake" stems from the four banks of 4-cylinder radial units stacked one on top the other. This light-weight 16 cylinder engine is upended on its gear box to keep space requirements to a minimum. Other radical departures in design required five years of cooperative research between Navy and General Motors engineers before the engine was ready. Then, just two months after Pearl Harbor, production got under way, and the pancake engines are now being installed in Navy ships.

HIGH-OCTANE gasoline, now available only for the military, will feed small, light peacetime autos, was reported by Dr. C. M. Larson, chief consulting engineer of the Sinclair Refining Company, to the Society of Automotive Engineers meeting in Cleveland. Production of this type of gasoline will probably be detrimental to diesel fuel ignition quality, and will force engineers to design diesel engines which will get the utmost out of low-cetane fuels. Dr. Larson believes that diesel fuels will be on the critical list by next year. He estimated that 1945 production ratio of gasoline to distillate fuel would be seven to one, compared with three to one at the start of the war.

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ENDOCRINE CONTROL OF PROSTATIC CANCER[1,2]

By Dr. CHARLES HUGGINS

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THERE is a high incidence of abnormal growth processes—of tumors, in the prostate gland of certain species in senescence. These species are man, the dog and the lion. For technical reasons, observations can be carried out with greater facility on the first two types than on the king of the beasts.

The most common neoplasia involving the prostate gland are benign nodular hypertrophy and carcinoma. The benign hypertrophy has been found[3] to involve the prostate gland in 45 per cent. of men over forty years in otherwise unselected autopsy material. Cancer of the prostate occurs[4,5] in at least 9 to 17 per cent. of men over fifty years; while many of these tumors are microscopic in size and, remaining latent, seldom are factors in morbidity or mortality, others invade and spread and become the cause of death of about 5 per cent. of men older than fifty years[6] in the United States. Plainly, neoplastic processes are usually present in the human prostate gland after the fifth decade, while a normal prostate is less common in old white men. Barringer, an eminent student of prostatic cancer, recently stated:[7] "The control of prostatic carcinoma presents one of the most difficult problems in the field of cancer. Many urologists believe seriously that its control is impossible."

[1] Address delivered on the occasion of the first award of the Charles L. Mayer Prize administered by the National Science Fund of the National Academy of Sciences, May 19, 1943.

[2] This investigation was aided by a grant from the Committee for Research in Problems of Sex, the National Research Council.

[3] M. B. Teem, *Jour. Urol.*, 34: 692, 1935.

[4] A. R. Rich, *Jour. Urol.*, 33: 215, 1935.

[5] R. A. Moore, *Jour. Urol.*, 33: 234, 1935.

[6] E. Baron and A. Angrist, *Arch. Path.*, 32: 787, 1941.

[7] B. S. Barringer, *Surg. Gynec. and Obst.*, 62: 410, 1936.

The prostatic cancers most commonly encountered consist either of undifferentiated sheets of cells or of adenocarcinomas wherein tiny glands are reproduced. These types have been observed in a very few animals, namely in one monkey[8] and three dogs,[9] and have not been produced experimentally. In rats, the implantation in the prostate of the carcinogen, 1 : 2, benzpyrine, was followed by squamous carcinoma,[10] a type rarely encountered in man; adenocarcinoma has not been reproduced experimentally.

The prostate is not known to produce a hormone and a considerable function of the gland is external secretion. The nature of the external secretion is of importance, since this fluid contains several unusual components; what seems bizarre is of the greatest interest to scientists, far overshadowing routine and predictable phenomena. Human prostatic fluid contains rather large amounts of calcium,[11] citric acid[12] and two enzymes, fibrinolysin—a moiety capable of rapidly destroying fibrin[13] and acid phosphatase, an enzyme of some importance, as will be seen.

The prostate gland is dependent for its existence in the adult or secretory state upon endocrine products and as far as is known upon only two types of hormones, androgens and estrogens. The male sex hormones or androgens cause an increase of size and the initiation and maintenance of the function of prostatic epithelium and in excess produce, fundamentally, hyperplasia. The estrogens, or female sex hormones in excess, cause a decrease in size and cessation of function of the tall columnar secretory epithelial cells —metaplasia. Further these fat-soluble compounds have the interesting physiological capacity of neutralizing the action of each other with respect to the prostate, when administered in appropriate amounts; nothing is known of the mechanism of antagonism of androgens by estrogens except that it is not a neutralization in the sense that acid neutralizes alkali. These basic reactions of the prostate to hormones may be easily demonstrated by the surgical procedure of prostatic isolation in dogs,[14] which permits frequent assay of the prostatic secretion for many months.

One of the directions that cancer research now is taking is the functional or physiological approach to the problem of tumors. The functional approach contrasts sharply with the descriptive approach—with the methods of classical pathology. It is concerned with the entire living organism rather than with sections or segments of the dead organism. In the functional approach the measure is of first importance: How much cancer activity is present? How can the activity be increased or decreased? Assay of a disease in a laboratory obviously removes much of the uncertainty inevitably associated with bedside observation, particularly in cancer. The yardstick in prostatic cancer concerns certain enzymes, the phosphatases.

"The metabolism of living cells is carried on by a diverse and intricate mosaic of enzyme catalysis. Under normal conditions and over the greater part of the life of the host, each tissue presents a steady and consistent enzymic pattern."[15]

The phosphatases are important in energy production in the cell. An enzyme capable of hydrolyzing phosphoric esters was discovered by Grosser and Husler[16] in intestinal mucosa in 1912; Robison[17] found that this enzyme was rich in growing bone and that it had its optimum activity at about pH 9. In certain bone diseases where there was abnormally increased osteoblastic activity, Kay[18] found that the "alkaline" phosphatase value of serum was abnormally increased; among these bone diseases is prostatic cancer which often metastasizes and involves bones, flourishing in this location.

Another phosphatase, with optimum activity at pH 5, was discovered in 1934, independently by Davies[19] and Bamann and Riedel,[20] in liver and kidney. Kutscher and Wolbergs[21] found that this "acid" phosphatase was rich in concentration in the prostatic secretion of man. The extensive and elegant studies of A. B. Gutman and Ethel Benedict Gutman have greatly elucidated the prostate-phosphatase relationships. The enzyme does not appear in appreciable amounts in human or monkey prostate tissue until puberty,[22] either naturally occurring or artificially induced with androgens,[23] when large amounts form. Cancer of the prostate also contains large amounts of the enzyme.[24] In certain patients with cancer of the prostate when the tumor has spread to lymph nodes or

[8] E. T. Engle and A. P. Stout, *Am. Jour. Cancer,* 39: 334, 1940.
[9] C. F. Schlotthauer and J. A. S. Millar, *Jour. Am. Vet. Med. Asn.,* 99: 239, 1941.
[10] R. A. Moore and R. H. Melchionna, *Am. Jour. Cancer,* 30: 731, 1937.
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[23] A. B. Gutman and E. B. Gutman, *Proc. Soc. Exp. Biol. and Med.,* 41: 277, 1939.
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bone, acid phosphatase values are increased in the blood,[25,26] constituting an important diagnostic test when high values are obtained. In many patients with advanced prostatic cancer both phosphatases are increased in serum; alkaline phosphatase because the bones are frequently involved with resultant increased osteoblastic activity and acid phosphatase because the tumor is prostatic in origin. Gomori[27] demonstrated by an ingenious histochemical staining method that acid phosphatase is elaborated by the normal secretory cells as well as by cancerous prostatic epithelium.

It then became apparent that the increased phosphatase values of adult secretory prostatic epithelium represented a secondary sex characteristic of an enzymic nature, and that usually prostatic cancer cells were at such a mature level that secretion occurred; this was of interest since in the past most cancers have been conceived to be composed of tissue resembling embryonic or primitive epithelium. It was known that with the possible exception of the anterior lobe of the prostate of guinea pigs[28] all secretory prostatic epithelium in mammals underwent diminution in size and function when the androgens were reduced in amount or in activity. Therefore, it was necessary to determine the effect of vitiation of androgens on prostatic cancer.

In a series of patients with advanced prostatic cancer the androgens were reduced by surgical removal of the testes or by estrogen administration, using as a yardstick the elevated serum phosphatases which were determined at frequent intervals.[29] Characteristically in man, such androgenic reduction is accompanied by a sharp fall in the amount of acid phosphatase to or towards normal and by a slower rise of alkaline phosphatase which after some weeks likewise decreased. These changes in alkaline phosphatase values apparently reflect healing in the bony lesions. The converse obtains in that the injection of androgen increases acid phosphatase values in prostatic cancer and aggravates the disease.

The inhibition of prostatic cancer by androgen control is not limited to beneficial effects on enzymes in blood serum. Among the earliest changes occurring in man are an increased appetite and relief of pain, often within several days after initiating treatment.[30] It is striking to see patients emaciated from malignant disease develop a voracious appetite. Pain in advanced prostatic cancer usually is severe and requires sedatives; this pain often disappears soon after castration. The increased food intake and decrease of pain promote a sense of well-being and more tangibly a gain in weight and increased blood formation so that the anemia accompanying the tumor frequently disappears, still further interrupting the vicious circle of the cancerous disease. Often there is a pronounced decrease in size of the neoplasm so that the palpably involved tissues, wherever they may be, return to normal; in deep recesses this apparent disappearance of the disease may be well followed in roentgenograms. Several patients with paralysis due to involvement of the spinal cord or nerve trunks with this cancer have had a disappearance of the neurologic changes and a return to a normal functional state.[30,31]

There have been no adverse psychic effects encountered, but certain undesirable effects attend androgen control. After castration most people develop the vasomotor phenomena known as hot flushes identical with those which are physiologic in occurrence in women at the menopause. Following estrogen administration men develop pain and swelling of the breasts. Moreover, in both instances whatever sexual activity remains, commonly slight, is usually abolished.

All in all, the improvement occurring after castration or estrogenic administration in prostatic cancer far outweighs the undesirable effects. It must be emphasized that the results are not uniformly successful and that they fall into three groups; one group, less than 5 per cent. of patients received no or slight benefit from endocrine treatment; the other groups, larger and nearly equal in number, obtained respectively an improvement pronounced but unsustained (less than eighteen months), or a pronounced and more prolonged regression of the disease. The improvement is greater than palliation, when technically the patient is merely made more comfortable in the face of advancing disease. The benefit in prostatic cancer often includes disappearance of the tumor, at least in the gross, and is considered as neoplastic inhibition. In clinical patients, castration seems to give somewhat better results than occur from estrogenic therapy.

The failure cases, where either no or an unsustained improvement occurs, are of great interest. As stated, in some of these cases endocrine modification produces a temporary atrophy, both of the original tumor and of the spread, to be followed in some months by reactivation of the disease; the recrudescence is always greater in the metastases than in the primary tumor. This is a strange phenomenon[32] when the previously

[25] A. B. Gutman and E. B. Gutman, *Jour. Clin. Investigation*, 17: 473, 1938.

[26] B. S. Barringer and H. Q. Woodard, *Trans. Am. Asn. Genito-Urin. Surgeons*, 31: 363, 1938.

[27] G. Gomori, *Arch. Path.*, 32: 189, 1941.

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[31] R. M. Nesbit and R. H. Cummings, *Jour. Am. Med. Asn.*, 120: 1109, 1942. B. G. Clarke and H. R. Viets, *Jour. Am. Med. Asn.*, 121: 499, 1943.

[32] C. Huggins, *Ann. Surg.*, 115: 1192, 1942.

hard, enlarged and nodular prostate gland becomes and remains soft and atrophic in the presence of the advancing neoplastic process elsewhere in the body. Clearly the prostatic tissue in bone marrow and lymph gland is located more strategically for its growth than in the original neoplastic site. Among possible causes of the failure cases are the production of significant quantities of androgen in extragonadal loci, as well as differences in the nature of original tumor. It has been established that varying, and at times, large, amounts of androgen are produced in the adrenal cortex of man; the adrenal androgens have been incompletely studied in prostatic cancer but obviously if significant amounts of androgens are produced in this region in certain patients, castration will effect incomplete regression of the tumor. It has been found that glandular types of prostatic cancer often but not always respond more favorably than undifferentiated tumors.

The urinary excretion of hormones in prostatic cancer has been studied.[33] The 17-ketosteroid excretion is reduced in amount as compared with vigorous young men, but not more so than in normal males of the same age group; following orchiectomy there is a decrease in their level followed in several weeks by a rise greater than the pre-operative values. The excretion of gonadotrophic agents is slightly increased after castration.

The concept of autonomy of the cancer cell in recent years has influenced thinking about cancer; according to this idea the malignant cell is dependent for its survival on few or no extraneous influences and proliferates even when solely dependent on catabolic effects of a starving host for its energy and growth. The present observations demonstrate that this concept is not general in application in the tumor field, since the prostatic cancer in man often is dependent on androgen for its survival.

In summary, it is possible by reducing the amount or the activity of circulating androgens to control, more or less but often extensively, far advanced prostatic cancer in large numbers of patients. In this special case, androgen control seriously disturbs the enzyme mosaic of the cancer cells at least with respect to the important energy producing protein-catalysts, the phosphatases. As a contribution to the problem of cancer treatment, it is well to emphasize that any interference with an important enzyme system of a cell, normal or malignant, will cause in that cell a decrease of size and function.

[33] W. W. Scott and C. Vermeulen, *Jour. Clin. Endocrinol.*, 2: 450, 1942. A. L. Dean, H. Q. Woodard and G. H. Twombly, *Jour. Urol.*, 49: 108, 1943.

COLORBLINDNESS AND THE DETECTION OF CAMOUFLAGE

By Dr. DEANE B. JUDD
NATIONAL BUREAU OF STANDARDS

ACCORDING to newspaper reports, colorblind observers have frequently been successful in spotting otherwise perfectly camouflaged positions. In order to show whether these reports can be believed, a brief analysis of the ways by which a normal observer can detect off-color camouflage must first be given.

NORMAL VISION

A normal observer can make color discriminations of three kinds: light-dark, blue-yellow and red-green. If a camouflaged position appears neither lighter nor darker, neither bluer nor yellower and neither redder nor greener than the surrounding terrain, the observer with his naked eye can not detect it because of its color; it is therefore perfectly colored and matches its background perfectly.

RED-GREEN BLINDNESS

The two most common forms of colorblindness are called deuteranopia and protanopia. Deuteranopes and protanopes are called colorblinds because they can not make red-green discriminations. To hide a position from such an observer as these it is sufficient to make it neither lighter nor darker, and neither bluer nor yellower than the background. It is not necessary to worry about whether the position is redder or greener than the surrounding terrain. These observers find it hard to pick out ripe strawberries from green or to pick out a rotten apple from a barrel of red apples, since the color differences involved are chiefly red-green differences. Since they can make yellow-blue discriminations quite as well as the normal observers, they are sometimes said to be only partially colorblind.

RED-GREEN WEAKNESS

There are two other forms of abnormal vision which have to be considered. They are forms of vision intermediate between normal vision and deuteranopia and protanopia, respectively. The form intermediate between normal vision and deuteranopia is known as deuteranomalous vision, that tending toward protanopia as protanomalous vision. There are more

anomalous observers of these types than there are partial colorblinds. About 2 per cent. of the male population would be classed as partially colorblind, and another 6 per cent. as anomalous, making altogether 8 per cent. abnormal. The protanomalous and deuteranomalous observers can make the three types of color discrimination possible for the normal observer, but their ability to make red-green discrimination is less than normal.

Other forms of colorblindness are relatively rare and associated with diseases of the eye; such eyes can not possibly compete with normal eyes for the detection of camouflage and can therefore be passed over. Likewise the fact that protanopes are distinguished from deuteranopes by being less sensitive to the long-wave (red) end of the spectrum than the normal observer has no separate special bearing on the detection of camouflage. But there is an important distinction between red-green blind and red-green weak observers, that is, between partially colorblind and anomalous observers which can conveniently be brought out by reference to an analysis of the ways by which a camouflaged position can be imperfectly colored.

COLOR FOR CAMOUFLAGE

If a position is concealed by being covered with material having the same reflecting properties throughout the spectrum as the surroundings, then it can not be detected. Such concealment can be approximated, for example, by using the actual vegetation or dirt of the surrounding terrain, and these methods are recommended by the Engineers Field Manual wherever practicable. Cut branches, however, rapidly change color from wilting of the leaves, and dirt after a rainstorm because of difference in rate of drying out may be a giveaway, although the spectral character of the material is very similar to that of the surrounding terrain. These are examples of the most common way by which a camouflaged position becomes imperfectly colored; this way may be called the imperfect use of spectrally correct materials.

Because of the impermanence of natural materials for camouflage, paint containing more permanent colorants is widely used for camouflage. Various branches of the War and Navy Departments have issued color standards for such paints. In the formulation of such paints it is desirable to choose pigments having spectral characteristics similar to those of the elements of terrain which have to be matched, but whenever the pigments are different from those coloring the terrain, some differences in spectral reflectance have to be tolerated. Therefore, if a paint is prepared to match an element of terrain for a normal observer, there will be portions of the spectrum at which the reflectances nevertheless differ. By viewing the two through a selective filter transmitting such a portion of the spectrum, the normal observer, or any observer, would be able to see one lighter than the other, although viewed with the naked eye they would match perfectly. Color matches involving such invisible spectral differences are sometimes called pseudo matches, but a preferred terminology suggested by Ostwald is to refer to them as metamers or metameric pairs. Such pairs as exhibit marked spectral differences are called highly metameric, and are said to exhibit a high degree of metamerism. Whenever paint is used for camouflage some degree of metamerism must be tolerated; such camouflage, however accurately adjusted by the naked eye, is always open to detection by the use of selective filters, or by photographic means, the conspicuousness of the installation being proportional to the degree of the metamerism.

Thus, there are two ways in which camouflage paint may be wrong; the components may be combined in improper proportion, or they may themselves be spectrally inappropriate.

REDUCTION SYSTEMS OF VISION

If a red-green-blind observer be shown a pair of samples which match to the normal observer, he will be unable to discriminate them. That is, normal metamers are also metamers for the red-green blind. On this account protanopia and deuteranopia are called reduction systems of vision. A red-green-blind observer fails to discriminate many pairs which are conspicuously different for the normal observer; and if the normal observer can not tell the color difference between two samples, neither can he. Therefore, if the camouflaged position be imperfectly colored solely because of choice of a spectrally imperfect material, there is no basis for expecting a red-green-blind observer to detect it.

The red-green weak observers, however, do not possess reduction systems. A metameric pair set up by a normal observer will usually be more or less off-match for a protanomalous or deuteranomalous observer. There is therefore a chance that an anomalous observer could with his naked eye detect a camouflaged position which would be undetectable by a normal or colorblind observer. But give the normal observer the correct spectral filter, and he could also detect the difference.

EFFECT OF THE BACKGROUND

We have seen that a colorblind observer can not detect camouflage, which is at fault solely because of spectrally imperfect materials. Any advantage in substituting a colorblind for a normal observer must therefore rest in the detection of positions whose colors are imperfectly adjusted to that of the sur-

rounding terrain. Let us inquire if there are likely kinds of blunders in applying camouflage which would be easier for the colorblind observer to detect than the normal.

A fairly common scene within which it is required to conceal a position is made up of patches of reddish-brown earth and yellowish-green foliage. The variegated pattern composed of these patches is well adapted to the concealment of a position from a normal observer. Even though it be somewhat too light or too bluish, the normal observer could fail to detect it because of the larger red-green differences in the scene. But consider the appearance of the scene to a red-green blind. The normal green of foliage to him appears dark-yellowish brown; the normal reddish brown of earth also appears dark-yellowish brown to him. He is not sensitive to the red-green differences which for the normal produce a variegated pattern; instead he may see a nearly uniform yellowish-brown field. Any element of terrain which is too light or too bluish could be quite conspicuous to such an observer. It is therefore possible to believe that a colorblind observer may detect camouflaged positions not detectable by the normal observer.

Can Colorblindness Be Produced by Filters?

It is a natural question to raise whether this possible advantage of the colorblind can be duplicated by giving a suitable viewing filter to a normal observer. The filter required to suppress normal red-green discrimination is, of course, one which transmits only in the blue and yellow portions of the spectrum. If a filter could be found, for example, which transmits the double band 450 to 490 mμ and 560 to 585 mμ, it would render the red-green differences between grass and earth about one fifth as prominent and at the same time preserve about the same prominence of any yellow-blue differences. However, such a filter would transmit less than 10 per cent. of incident daylight, probably much less. It is a question whether any improvement in detection of lightness differences or yellow-blue differences would be obtained by a normal observer in this way even against a highly variegated red-green background. It should be noted that such a filter, although it would render a normal observer relatively blind to red-green differences, by no means makes him equivalent to either a protanope or a deuteranope. Such a filter would endow the subject of the experiment with a luminosity function having two separate maxima, one at about 470 mμ, the other at about 570 mμ, whereas the deuteranope has a nearly normal luminosity function whose maximum is at 555 mμ, and the protanope a similar function with the maximum shifted to about 540 mμ. It is possible to produce the phenomena of color blindness separately by means of filters, but they can not all be bestowed in this way upon a normal observer at the same time.

OBITUARY

WALTER BEAL ELLETT

Walter Beal Ellett, head of the department of agricultural chemistry at the Virginia Polytechnic Institute and chemist for the Virginia Agricultural Experiment Station, died in Blacksburg, Va., on May 12, 1943. Dr. Ellett was born at Central Depot, now Radford, Va., on November 11, 1874. He was graduated from Virginia Tech in 1894 and immediately made an instructor in chemistry, earning his master's degree in 1896. He went to Germany in 1900 and graduated from the University of Goettingen in 1904 with the M.A. and Ph.D. degrees. While in Germany he studied under Tollens, Wallach, Nernst and Fleischmann. He was made head of the agricultural chemistry department in 1915, succeeding the late Professor Robert J. Davidson. He had been chemist of the Virginia Agricultural Experiment Station since 1906. Dr. Ellett was a member of the American Chemical Society and a fellow of the American Association for the Advancement of Science. His research at Virginia Tech has resulted in practical contributions to the fields of soil fertility, nitrification, fixation of phosphoric acid by the soil and fermentation. His many researches have been published in the various scientific journals and as bulletins of the Virginia Agricultural Experiment Station.

H. H. Hill

Virginia Polytechnic Institute

RECENT DEATHS

Dr. Arthur Willis Goodspeed, professor emeritus of physics of the University of Pennsylvania, died on June 6 at the age of eighty-two years. Dr. Goodspeed was secretary of the American Philosophical Society from 1901 to 1935.

Dr. Albro David Morrill, professor of biology at Hamilton College from 1896 until his retirement in 1928 with the title emeritus, died on June 8 in his eighty-ninth year.

Dr. Fred W. Hinds, dean of the College of Dentistry of Baylor University, died on June 4 at the age of fifty-five years.

Sir Arthur Newsholme, from 1908 to 1919 principal medical officer of the London Local Government Board, died on May 17 at the age of eighty-six years.

Sir Arthur in 1919 was visiting professor of hygiene and public health at the Johns Hopkins University.

PROFESSOR GUIDO FUBINI, formerly professor of mathematics at the University of Turin and since 1939 a member of the Institute for Advanced Study at Princeton, N. J., died on June 6 at the age of sixty-four years.

THE death is announced of Dr. Peter Muehlens, director of the Hamburg Institute for Tropical Diseases. He was sixty-nine years old.

SCIENTIFIC EVENTS

FIELD TRAINING IN HEALTH EDUCATION AT CLEVELAND HEALTH MUSEUM

TWENTY-SEVEN students in health education from the University of North Carolina will work from August 9 to September 4 as interns at the Cleveland Health Museum to receive a course of instruction, do laboratory work and gain field experience in methods of health education, especially in health exhibits. Among those students are seventeen individuals who were awarded fellowships by the U. S. Public Health Service, from a grant made available by the W. K. Kellogg Foundation.

The four-week course at the museum is part of a three-months' supervised field experience required in addition to nine months' academic training in order to obtain the degree of master of science in public health. The postgraduate students come from sixteen states: Arizona, California, Colorado, Illinois, Indiana, Missouri, Nebraska, New Hampshire, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Washington and Wyoming. One student comes from Lima, Peru. Many have been already engaged in health work, such as directors of school cafeterias, teachers of physical education or home economics in colleges, assistant directors of state hospitals, nutritionists, etc.

The course will be conducted by Dr. Bruno Gebhard, who is director of the Cleveland Health Museum and an associate in health education at the School of Medicine of Western Reserve University.

Besides instruction in the principles and methods of visual health education the students will gain practical experience in three work units. The first one deals with ideas, facts, figures and manuscripts. Another unit is centered around designing, constructing and budgeting of exhibits. A third will handle placement, publicity, visitors' reaction and follow-up.

The museum's facilities, including exhibits, the workshops, the loan service and the film library, will be used for this training.

THE AMERICAN FOUNDATION FOR TROPICAL MEDICINE

THE medical advisory committee of the American Foundation for Tropical Medicine authorized grants to six North American medical schools amounting to $26,100 during the first quarter of 1943, according to a report by Dr. J. A. Curran, dean of the Long Island College of Medicine, executive director, at a meeting of directors of the foundation in New York City on April 14.

These grants, made possible by contributions and pledges for the current year of $60,100 by nineteen American corporations, are being used to strengthen teaching or research programs in tropical medicine and parasitology at the various schools. The approved projects were selected by the medical committee among a number of applications.

Medical schools to receive aid were: the College of Medicine of New York University; Medical School of Tufts College; School of Medicine of Tulane University; the Faculty of Medicine of the University of Manitoba; the College of Medicine of the University of Nebraska and the School of Medicine of Yale University.

Companies that have made contributions or formal pledges of support include: Abbott Laboratories; American Cyanamid Company; Ciba Pharmaceutical Products Corporation; Firestone Plantations Company; General Foods Corporation; Hoffmann-La Roche, Inc.; the Lambert Company; Lederle Laboratories; Eli Lilly and Company; Merck and Company, Inc.; National Carbon Company; Parke, Davis and Company; E. R. Squibb and Sons; United Fruit Company; William R. Warner and Company; Winthrop Chemical Company; Winthrop Products, Inc., and John Wyeth and Brother. Other applications are pending and those that are approved will be financed out of contributions.

The program of the foundation adopted at the annual meeting of members in January calls for the collection and disbursement of $100,000 among medical schools and scientific journals and for special projects which fall within its scope. Dr. Curran stated that the full sum of $100,000 would be needed to complete the program.

The officers of the foundation are: *President,* Lt. Col. Thomas T. Mackie, executive officer, Division of Parasitology and Tropical Medicine, Army Medical School; *Vice-president,* Dr. Willard C. Rappleye, dean of the College of Physicians and Surgeons, Columbia University; *Secretary,* Alfred R. Crawford, assistant to the president of Long Island College of Medicine; *Treasurer,* W. W. Lancaster, partner,

Shearman and Sterling; and *Executive Director,* Dr. Curran, president and dean, Long Island College of Medicine.

Members of the executive committee, in addition to the above officers, are: Dr. Theodore G. Klumpp, *President,* Winthrop Chemical Company, Inc., and Dr. Henry E. Meleney, professor of preventive medicine, College of Medicine of New York University.

The purposes for which the funds granted are being utilized are as follows:

Manitoba.—Traveling fellowship for professor of parasitology and tropical diseases.

New York University.—Salary aid for full-time instructor in tropical medicine and parasitology.

Nebraska.—For full-time technical assistant to assist teaching in student laboratories and staff research.

Tufts.—To employ clinical teaching fellow in tropical medicine.

Tulane.—Budgetary needs of department of tropical medicine which since 1940 has trained forty-one physicians from Central and South American countries, from Africa and from Asia.

Yale.—To supplement salaries of teachers and laboratory assistants in order to expand tropical medicine teaching.

RATIONING AND EXPERIMENTAL LABORATORIES

THE question of the procedure for obtaining rationed foods for experimental purposes has been raised by a number of research institutions. In order to help those having difficulty in satisfying their needs, the following note has been prepared by the Food Distribution Administration:

Amendment 18 to General Ration Order Number 5, issued on April 24, states that, "On and after May 1, 1943, any use of a rationed food for experimental, educational, testing or demonstration purposes is an industrial and not an institutional use." This amendment lists experimental laboratories as industrial users and therefore requires them to proceed as directed under the institutional and industrial users sections of the various ration orders.

An industrial user (laboratory) registers, either in person or by mail, with the local board serving the area in which his principal office is located and receives an allotment to enable him to obtain and use foods covered by food rationing orders.

An application for the opening of a new establishment (laboratory) or original application to obtain rationed commodities must be made on OPA Form R-315. Such application should be submitted to the local War Price and Rationing Board which serves the area in which the establishment (laboratory) or its principal business office is or will be located. The local board will forward the application with its recommendation and all supporting data to Washington for appropriate action.

An application by an industrial user (laboratory) for allotment of a specific rationed food must be made in the following manner:

Sugar: If the applicant (laboratory) used sugar in 1941, his allotment will be based on actual usage during that year. He must register on OPA Form R-310 and apply for his allotment on R-314. The local board shall take appropriate action.

If the applicant did not use sugar in 1941, his allotment will be granted by the local board in accordance with the ruling received from Washington where the petition shall be sent by the local board.

Coffee: A laboratory which uses coffee for experimental purposes is considered a Class "A" industrial user of coffee, *i.e.*, a "person who uses roasted coffee in the preparation of a beverage which he does not serve." He must apply to his local War Price and Rationing Board which shall determine his monthly allotments.

Processed Foods: The applicant shall register on OPA Form R-1308, and include a record of his historical use of processed foods on which subsequent allotments will be based.

Meat, Cheese, Butter and Edible Fats and Oils: The applicant shall register as an industrial user on OPA Form R-1605 and include a record of his historical use of foods rationed under Ration Order 16 and his inventory of such rationed foods as of March 28, 1943. Allotments will be issued accordingly.

Sections 1407.81 to 1407.95 of Ration Order 3 cover the industrial use of sugar. Sections 1407.1015 to 1407.10175 of Ration Order 12 cover the industrial use of coffee. Article VI of Ration Order 13 and Amendment 10 to that order cover the industrial use of processed foods. Article VII of Ration Order 16 covers the industrial use of meats, cheese, butter and the edible fats and oils.

Additional information as to the procedure for obtaining rationed foods for experimental purposes as well as copies of the various rationing orders, amendments and necessary forms may be obtained from local War Price and Rationing Boards.

TRAINING FOR WOMEN IN AERONAUTICAL ENGINEERING AT THE UNIVERSITY OF CINCINNATI

DETAILS of a special war-training program developed with the Goodyear Aircraft Corporation to prepare selected groups of college women for specific types of work with the Akron, Ohio, firm have been announced by the University of Cincinnati.

Sponsored by the Goodyear Corporation, the program, starting on July 1, will train young women in aeronautical engineering in the College of Engineering and Commerce to qualify them for employment as junior engineers. The company will carry the cost. Applicants must have attended college at least one year and have general aptitude for mathematics. W. S. Dowman, of the Goodyear Corporation, is re-

ceiving applications for enrolment at his office in Akron. He is the corporation's manager for salary personnel.

The students will receive six months' instruction at the University of Cincinnati, and at the end of this training will be employed in the engineering department of the Goodyear Company. While at the university, the students will receive not only free tuition but also board, lodging and spending money. Other groups of young women will come to the university for this training when the first class has completed its work.

Since the Goodyear Corporation was the pioneer in this country in the construction of dirigible balloons, both small blimps and monster rigid types, and, within recent years, airplane assemblies have been constructed at Akron, the students will be taught the basic principles of both airplane and airship design.

The work at the College of Engineering and Commerce of the University of Cincinnati will be under the supervision of Professor Bradley Jones, head of the department of aeronautical engineering. The subject-matter of the course has been planned by close cooperation between Professor Jones and the Goodyear Company.

CONVENTION OF PSYCHOLOGISTS

AN Intersociety Constitutional Convention of Psychologists met in New York on May 29 and 31. Twenty-six delegates were present from the American Psychological Association, the American Association for Applied Psychology, the Society for the Psychological Study of Social Issues, the Psychometric Society, the Society of Experimental Psychologists, the National Institute of Psychology, Section I of the American Association for the Advancement of Science, the National Council of Women Psychologists and the Department of Psychology of the American Teachers Association. Dr. Robert M. Yerkes, chairman of the Survey and Planning Committee, a subcommittee of the Emergency Committee in Psychology of the National Research Council, opened the convention as temporary chairman. The elected officers were Edwin G. Boring, *Chairman;* Alice I. Bryan, *Secretary;* Ernest R. Hilgard, *Vice-chairman;* Edna Heidbreder, *Vice-secretary.* The purpose of the convention was the consideration of the amalgamation or cooperation of existing psychological societies in the furtherance of their scientific and professional aims, especially in the war effort and in the promotion of national welfare after the war. The following motion was passed: "Moved, that, having given careful consideration to the various proposals placed before us, this convention records its decision that the objectives in view can be most effectively and economically achieved through a closer and more organic tie between the reconstituted present national psychological societies and their present affiliates." Dr. Ernest R. Hilgard was appointed chairman of a continuing committee to give precise verbal form to the will of the convention for submission to the constituent societies for their adherence.

COPERNICUS CELEBRATION AT THE POLISH INSTITUTE OF ARTS AND SCIENCES IN AMERICA

THE Polish Institute of Arts and Sciences in America presented on May 3, Polish Constitution Day, before a distinguished audience of about one hundred and fifty persons a Copernicus-Constitution Day memorial program. Five speakers participated in the program in which Copernicus was represented as a natural product of the highly developed Polish civilization which existed even early in the sixteenth century.

The historian, Professor Oskar Halecki, of the University of Warsaw, well known in American universities as a popular lecturer, presided in his capacity as director of the institute.

As first speaker on the program, the president of the History of Science Society, Louis C. Karpinski (mathematics, University of Michigan), indicated the place of Copernicus in the history of science. In the development of the printing press and a newly added western hemisphere, the way had been prepared for a new view of the celestial universe. A light touch was added for a popular audience by the references to the fact that the night life of the stars, particularly eclipses and other irregularities in the wanderings of the stars, contributed much to the developments of planetary astronomy.

The French astronomer, Professor Alexandre Koyre (Ecole des Hautes Etudes, Sorbonne; and Ecole Libre des Hautes Etudes, New York), presented a paper on "The Copernican Revolution in Astronomy." The speaker prepared some ten years ago a French translation of the "De Revolutionibus" by Copernicus. Professor Rafal Taubenschlag, who is known for his studies in ancient Roman law, presented "The University of Cracow in the Age of Copernicus." The purpose of the paper, "Polish Literature in the Age of Copernicus," by Professor Waclaw Lednicki, was to show that the astronomical literature in Poland is part of a larger literary movement. Professor Lednicki has held a chair of literature in Cracow, also in Brussels, and now lectures at Harvard University. The director of the Polish Institute, Oskar Halecki, gave the final paper entitled "From Copernicus to the Constitution of May 3, 1791."

L. C. K.

IN HONOR OF DR. TREAT B. JOHNSON

A TESTIMONIAL dinner to Dr. Treat B. Johnson, Sterling professor of chemistry at Yale University, honoring his long service at the university, was given on the evening of June 7 at the New Haven Lawn Club by his university colleagues in the department of chemistry and a group of his former students, who had received their Ph.D. degree for research in organic chemistry under his direction. Professor Johnson is retiring from active service this year with appointment to a Sterling professorship emeritus.

Dr. Johnson has been connected with Yale University continuously since 1894, when he registered as a freshman in the Sheffield Scientific School. He has completed forty-three years of active teaching service at the university, having received his Ph.D. degree in chemistry in 1901.

Speakers at the dinner were Dr. Charles H. Warren, dean of the Sheffield Scientific School and professor of mineralogy; Dr. Elmer V. McCollum, professor of biochemistry at the School of Hygiene and Public Health of the Johns Hopkins University; Dr. William T. Read, professor of chemistry at Rutgers College, and Dr. Arthur J. Hill, Whitehead professor of chemistry at the university.

In recognition of his long and outstanding work at Yale and his contributions to the fields of organic chemistry and biochemistry, Professor Johnson was presented with a complete Shaeffer writing desk equipment and a G.-E. Mazda fluorescent lamp.

SCIENTIFIC NOTES AND NEWS

DR. HERMAN LOUIS KRETSCHMER, of Chicago, was chosen president-elect of the American Medical Association to succeed next year Dr. James E. Paullin, of Atlanta, at a meeting in Chicago from June 7 to 9, of the House of Delegates. Dr. John J. Amesse, of Denver, was elected vice-president, and Dr. Josiah J. Moore, of Chicago, was elected to succeed Dr. Kretschmer as treasurer.

MAJOR GENERAL NORMAN T. KIRK has succeeded Major General James C. Magee as Surgeon General of the Army.

AT the commencement exercises of New York University on June 9, the doctorate of laws was conferred on Dr. George Dinsmore Stoddard, professor of psychology at the State University of Iowa for seventeen years, director of the Iowa Child Welfare Research Station and dean of the Graduate School. Dr. Stoddard is now New York State Commissioner of Education and president of the University of the State of New York. The doctorate of laws was conferred also on Dr. Herman H. Horne, professor of education emeritus. The degree of doctor of engineering was conferred on Lieutenant General Brehon Burke Somervell.

JOHN T. ZIMMER, curator of the department of birds of the American Museum of Natural History, New York, editor of *The Auk,* on May 24 received the honorary degree of doctor of science at the annual commencement of the University of Nebraska.

AS announced in the proceedings of the North Carolina Academy of Science, Dr. H. S. Perry, of Duke University, has won the first prize award of the academy for a paper on "The Control of Starchy Contamination in Sweet Corn by the Use of the 'Gamete' Gene." This paper will be placed in the Inter-academy Contest for the Southeastern States, to be judged by a committee of the American Association for the Advancement of Science.

DR. MAX M. STRUMIA, of Bryn Mawr, Pa., has been awarded the Ward Burdick gold medal of the American Society of Clinical Pathologists for his work in connection with methods of preparing blood plasma.

THE Howard Taylor Ricketts Prize of the University of Chicago has been divided between Dr. Howard C. Hopps, instructor in pathology, and Dr. Leo R. Melcher, formerly assistant in immunology in the department of bacteriology and parasitology, now a student at Northwestern University Medical School.

THE Albert Gold Medal of the Royal Society of Arts, London, has been awarded to Sir John Russell, director of Rothamsted Experimental Station, which this year celebrates its centenary.

DR. A. HARDISTY SELLERS, medical statistician, Department of Health, Ontario, squadron leader, Royal Canadian Air Force, has been awarded the Professional Institute Medal of the Professional Institute of the Civil Service of Canada in recognition of the important contribution made by him in the study of hospital statistics in Ontario in connection with the cost of medical care.

THE following officers of the Stanford Chapter of Sigma Xi for the year 1943–44 were elected at a meeting of the chapter on May 13: *President,* Professor George W. Beadle, biology; *Vice-president,* Professor Hubert Schenck, geology; *Secretary-treasurer,* Professor H. M. Bacon, mathematics; *Assistant Secretary-treasurer,* Professor Willis H. Johnson, biology. New members and associates were initiated at a meeting on May 28, at which time an address on "Plant Distribution" was given by Dr. Douglas H. Campbell, emeritus professor of botany.

AT the final meeting of the Pittsburgh Physical Society for the 1942–43 season, which was held on June 3 at the Mellon Institute, the following officers were elected for next year: *President,* Dr. Sigmund I. Hammer; *Vice-president,* Dr. Sidney L. Siegel, and *Secretary-Treasurer,* Dr. Mary E. Warga. An address was delivered by the retiring president, Dr. O. Stern, on the "Corpuscular and Wave Properties of Molecular Rays."

THE National Association of Science Writers, meeting at the American Medical Association convention in Chicago on June 9, elected as president Robert D. Potter, of New York, science editor of the *American Weekly.*

AT the recent annual meeting of the Supervisory Board of the American Year Book, an organization composed of delegates from forty-five learned societies, Professor Marston Taylor Bogert, of Columbia University, the representative of the American Chemical Society, was reelected to the presidency of the board, and Rear Admiral George H. Rock, the delegate from the Society of Naval Architects and Marine Engineers, was reelected to the vice-presidency.

DR. DONALD B. KEYES, chief of the chemical industries branch of the Office of Production, Research and Development of the War Production Board, and Raymond E. Kirk, of the Brooklyn Polytechnic Institute, have been elected to three-year terms as councilors of the American Institute of Chemists, Chicago. Frederick A. Hessel, president of the Montclair Research Laboratories, has been named treasurer.

THE following officers for 1943–1945 of the Cincinnati Chapter of the Society of Sigma Xi were installed at a meeting of the chapter on May 28: *President,* John L. Rich, professor of economic geology; *Vice-president,* Dr. Hoke S. Green, associate professor of organic chemistry, and *Secretary-Treasurer,* Dr. Paul B. Arenson, professor of inorganic chemistry. Dr. C. A. Elvehjem, professor of agricultural chemistry at the University of Wisconsin, delivered the annual lecture. He spoke on "The Present Status of the Vitamin B Complex."

DR. MARION FAY, professor of physiological chemistry at the Woman's Medical College of Pennsylvania, has been appointed acting dean for the duration of the war to fill the vacancy caused by the commissioning of Dr. Margaret D. Craighill as major in the Medical Corps, U. S. Army.

DR. ESTHER CARPENTER, holder of the Elizabeth Clay Howald Scholarship at the Ohio State University, will return in July to Smith College where she has been appointed associate professor of zoology. She has been studying the effect of temperature on thyroid grown in tissue cultures.

DR. HERBERT S. BREYFOGLE, a fellow in legal medicine at Harvard Medical School, has been appointed instructor in pathology at the Washington University School of Medicine and pathologist to the St. Louis County Hospital. He will serve also as pathologist to the coroner of St. Louis County.

DR. CARL VOEGTLIN, first director of the National Cancer Institute, which was established in 1937, will retire from the U. S. Public Health Service on July 31. He has been with the service since 1913; was commissioned medical director in 1931, and has been in charge of all cancer research since 1937.

DR. EDWARD A. STRECKER, professor and head of the department of psychiatry at the Graduate School and the Medical School of the University of Pennsylvania, president of the American Psychiatric Association, has been named special consultant to the Secretary of War for the Air Forces of the United States Army. In this capacity, Dr. Strecker will act as adviser to War Secretary Henry L. Stimson on all questions relating to psychiatry in the Air Forces. Serving as a civilian adviser he will be on call at all times by the War Department.

THE California Central Fibre Corporation has appointed Dr. Dorothy Day plant physiologist in its department of plant research at Pisgah Forest, N. C.

JOHN A. FAUST has joined the staff of the Bakelite Corporation, unit of Union Carbide and Carbon Corporation, at the Research and Development Laboratories in Bloomfield, N. J.

DR. PHILIP S. WINNEK has become director of research of Pitman-Moore Co., Indianapolis, pharmaceutical and biological manufacturers.

DR. J. BEN ROBINSON, president of the American Dental Association, was the guest of Mexican dentists at the fourth Medico-Dental Convention in Mexico City in March. At the request of the State Department Dr. Robinson extended his trip to visit dental groups in the leading cities of Mexico. Dr. Daniel F. Lynch, chairman of the Pan American Relations Committee of the American Dental Association, accompanied Dr. Robinson.

DR. HUBERT G. SCHENCK, professor of geology, has been granted an indefinite leave of absence from Stanford University in order to accept a commission as major in the Army.

DR. RICHARD A. HOWARD has been appointed Second Lieutenant in the Army of the United States. He has been assigned to duty with the Army Air Forces as an aviation physiologist.

DR. PEYTON ROUS, of the Rockefeller Institute for Medical Research, writes: "All admit and most admire

the wild genius shown by the printer in his errors. Yet surely he should not have stated, in SCIENCE of June 4, page 505, that the castration of patients with inoperable prostatic cancer is followed by 'dramatic happiness.' The word was "happenings'."

THE *Journal* of the American Medical Association reports that Dr. Walter B. Cannon, professor emeritus of physiology of the Harvard Medical School, is the president of the American-Soviet Medical Society, a new group founded to meet an increasing demand for information about the results and achievements of Soviet medicine. Dr. Henry E. Sigerist, director of the Institute of the History of Medicine at the Johns Hopkins University, Baltimore, is the editor of a journal to be published by the society, to be known as the *American Review of Soviet Medicine*. Temporary offices of the society are at 130 West 46th Street, New York. Through meetings, the publication of a journal and the establishment of a library of information, the society keeps physicians of America and members of the allied professions informed on what problems Soviet colleagues are working and what is being done to solve these problems. The society will also send American medical books and periodicals to the Soviet Union to keep the Russians informed of scientific developments in this country and to stimulate closer cooperation between the medical corps of the two countries. As soon as conditions permit after the war, the society hopes to promote the exchange of students and to sponsor study hours in the two countries.

THE University of Rochester ultimately will receive an estimated $1,784,275 for use as a research fund through the will of Mrs. Bertha H. Buswell, of Buffalo. Her will directed that the money be used to establish the "Bertha H. Buswell and Dr. Henry C. Buswell Memorial" for research work by the department of internal medicine of the School of Medicine. This amount represents the residue of her estate and is subject to a life interest by her brother. The late Dr. Buswell bequeathed $900,000 for the use of the department of urology in the medical school.

THE Texas Dental College, Houston, Texas, has been made a part of the University of Texas and is now officially known as the School of Dentistry of the University of Texas.

THE Bausch and Lomb Optical Company has announced the successful casting of the largest prism ever made—an optical disc twenty-six inches in diameter, graduated in thickness from 1½ to 3½ inches and weighing 260 pounds. It was made for the Burrell telescope in the Warner and Swasey Observatory of the Case School of Applied Science at Cleveland.

THE editor of *Chronica Botanica* states that word has been received from a trustworthy Swedish correspondent that the herbarium and library buildings of the Botanical Museum in Berlin-Dahlem were completely destroyed during an air raid on the night of March 1 and 2. Practically nothing had been evacuated. With the exception of the fern herbarium and part of the fungi everything is gone. According to an official statement, publication of *Die Natürlichen Pflanzenfamilien* and *Das Pflanzenreich* will be discontinued.

THE foundation by the Royal College of Surgeons, London, of a research chair in ophthalmology, tenable at the Royal Eye Hospital, Southwark, has been announced. It is the first chair of its kind in England and the hospital has undertaken to raise £40,000 for its permanent endowment. The holder of the chair (the appointment has yet to be made) will devote the whole of his time to clinical research at the hospital and laboratory work at the Royal College of Surgeons.

A CABLE to *The New York Times* states that two more historic houses have been given to Great Britain in trust for preservation, Sir Isaac Newton's birthplace, Woolsthorpe Manor, near Granthan, Lincolnshire, and St. John's Jerusalem in Sutton-at-Hone, Kent. The gift of Woolsthorpe Manor was made possible through the generosity of the Pilgrim Trust, whose purchase of the property a few months ago to turn it over to the nation had already been announced. Many of the original features of the Newton birthplace have been preserved.

THE *Times*, London, reports that tunnellers of the Royal Engineers who continue blasting and boring their way into the heart of the Rock of Gibraltar have discovered a cavern which may have been sealed for 20,000 years. The cavern is of extraordinary beauty, glimmering white, gray and red stalactite columns, resembling a cathedral with pulpit, chancel and organ-pipes. The chamber contains a lake of fresh water nearly forty yards long and from seven feet to twenty feet deep. The largest column is seven feet in diameter and forty feet high.

DISCUSSION

THE SCIENCE MOBILIZATION BILL

IN reply to the letter of Dr. L. C. Dunn appearing in SCIENCE for June 4 attacking the statements, "95 per cent. of our scientific and technical manpower and facilities are now highly organized and coordinated to the single end of advancing the war effort" and

"practically every laboratory in the nation is in the service of the nation," I cite William L. Laurence's studies[1] of January 3, 1943, in addition to my own.[2]

Mr. Laurence states that "of the university research workers, fully 96.5 per cent. are now directly engaged in war work, with only 700 full-time research workers still available for this purpose. Among the industrial research laboratories in the fields of physics; chemical, electrical, and mechanical engineering, 93 per cent. of the personnel is working on war assignments." Since January, the percentage is probably higher in each group.

Any one who has had to do with engaging the services of or has served on governmental committees to find scientific and technical personnel knows that it is almost impossible to find any one who is not engaged in the war effort. At the last national meeting of the American Chemical Society held in Detroit in April, 1943, the Employment Bureau for Chemists found that there were six employers or more for every qualified chemist looking for a position. The scarcity of physicists and other scientists is even greater, judging from the difficulty the Army and Navy and war industries are having in filling their needs.

There are 630,770 persons[3] registered in the National Roster of Scientific and Specialized Personnel as of April 24, 1943. Of this group, 399,179 are physicians, dentists and veterinarians with the balance distributed as follows:

Chemistry	80,605
Civil Engineering	34,053
Electrical Engineering	22,027
Mechanical Engineering	21,669
Physics	11,054
Mathematics	9,154
Geology	9,028
Economics	7,990
Chemical Engineering	7,967
Biology	7,170
Psychology	5,933
Radio Engineering	5,630
Aeronautical Engineering	4,825
Automotive Engineering	3,265
Naval Architecture	1,221

It is interesting to note that the physicians and dentists are exempt from any rulings of the Kilgore Senate Bill 702. One may point out also that the Kilgore Bill defines as "scientific and technical personnel" "any one who has completed any course of study in any college or university in any branch of science or its practical application or who has not less than an aggregate of six months' training or employment in any scientific or technical vocation." (Sec. 2 Pt. b. S 702, 78th Congress.)

[1] *New York Times*, January 3, 1943.
[2] *The Chemist*, April, 1943, Vol. 20, 227, 1943.
[3] *New York Times*, April 24, 1943.

When Dr. Dunn makes the statement quoting[4] data of 1942 that there are "thousands of biologists of all kinds, of geologists, of mathematicians, and other scientists whose work has no immediate relation to the war," we again cite Laurence, who reports that there are now "87 per cent. of the mathematicians and 83 per cent. of the biologists in the research field who are now directly engaged in research problems in connection with the war."

When Dr. Dunn questions the truth of "There are no secrets in the oil industry for the duration" he has ignored completely the Honorable Harold L. Ickes, Petroleum Administrator for War, who addressed the American Petroleum Institute in Chicago on November 11, 1942, when he stated:

> You accepted our idea of district committees representing the industry through the country to consult with and advise us on the problems of producing, refining, transporting, marketing and conserving oil. As a result we have had, for more than a year, approximately three hundred of the leaders of your industry working continually with us in the multifold and worrisome task of making that priceless commodity do its part first in defense and now in war.
>
> The cooperative idea took hold. It worked. It worked so well that during the fall we decided to carry it further. The district committees had functioned adequately on regional matters, but an increasing number of our problems had national ramifications that called for a grouping which could operate on a national scale. Realizing this, I appointed seventy-two leaders of the industries as what is now known as the Petroleum Industry War Council. As in the case of the industry committees it represents both large and small interests. On it also are representatives of oil associations and cooperatives.
>
> This council was appointed on November 28, 1941, and the first meeting was held ten days later; and thus wholly without premonition even if I was responsible for what a member of the Council termed one of the great coincidences of history. The first meeting was held the day after Pearl Harbor. The President had not yet gone before Congress to ask for a formal declaration of a state of war but every man present sensed that the oil industry had already mobilized for a war in which the future of America itself was at stake. Around the table were the big names of the industry, heads of powerful integrated companies whose plants are familiar to every motorist. Yes, and also around the table were the leading independents and with them men whose names the average citizen would not recognize if he heard them—names that meant that the little fellows had just as much voice in the councils as the so-called majors.
>
> It is no military secret that in the summer of 1941, we were dangerously short of the capacity for making 100 octane (gasoline). Our production at that time, as you know, was only about 40,000 barrels a day and one four-motored bomber can use several barrels in a single hour of flying.

[4] J. S. Nicholas, *American Scientists*, 30: 297–298, 1942.

I wish that I might make public as a tribute of your industry the present production of 100 octane because it represents a near miracle, the proportions of which can not unfortunately be appreciated by anyone who does not understand the intricacy of the refinery equipment which is necessary and the complications of processes involved. It has been achieved because we have had a smoothly functioning government-industry partnership. Because the holders of patents of complicated processes which have been developed over many years at huge expense agreed to make those processes available at sharply reduced royalties to all who would participate in the effort. Because the experts of our office and those of your industry together work wonders in improving processes and in devising ways to avoid the use of scarce materials: Because rival companies were willing to share with one another their raw materials, their knowledge and their facilities. Because, in brief, there was the will to do and the organization to do it.

As one who has worked on many projects of which the Honorable Harold L. Ickes is speaking, I know that there are no "secrets in the oil industry for the duration."

Dr. Dunn questions the motives in back of my opposition to the Kilgore bill and asks, "Is it concern for the public good or for corporation profit?" My answer is both. I believe we still live in a free enterprise system and that this system has made the United States the great country it is, and much of this greatness is based squarely on the patent system.

He quotes only the title to Section 7 "Protection of the Public Interest in Discoveries and Developments Financed by the United States." Section 7 (a) reads as follows:

Any provision of law to the contrary notwithstanding, the Office is hereby vested with the exclusive right to use, and with the exclusive right to license others to use, (1) any invention, discovery, patent, or patent right which has heretofore resulted, or shall hereafter result, from research or invention for the carrying on of which the United States or any department, agency, or establishment thereof either has heretofore contributed at any time since the declaration of national emergency on May 27, 1941, or shall hereafter contribute, any money, credit, physical facilities, or personnel; and (2) any invention, discovery, patent, or patent right which is at the time of the enactment of this Act, or shall hereafter become, to any extent the property of the United States or of any department, agency, or establishment thereof.

As I understand this paragraph, it means that if the United States Government invested but $100 or furnished a single piece of equipment, or one individual with six months or more experience, it would have the rights to the patents, etc., flowing from the institution which has been assisted to that extent.

Dr. Dunn suggested that the directors of the American Chemical Society were biased when they stated that the Kilgore bill would "confer totalitarian powers." As a member of the American Chemical Society, I am in wholehearted agreement with the action of its directors. I have known each and every one of the directors of this society for many years and they are men of unimpeachable integrity.

My understanding is that other scientific and technical societies have opposed the Kilgore bill. Some of them are The American Electrochemical Society, American Institute of Chemical Engineers, American Institute of Mining and Metallurgical Engineers, The American Association of Engineers, The American Institute of Chemists, The National Society of Professional Engineers and the American Society of Civil Engineers.

GUSTAV EGLOFF,
President, American Institute of Chemists

RADIONICS

RIGHT now the public is being confused in the press and on the radio daily by two terms which mean exactly the same thing—"electronics" and "radionics." Electronics is of British origin and radionics has been used in our own country for some time, although I don't know who originated it.

Both these terms deal with the application of vacuum tubes in electrical circuits not only for broadcasting and radio communications, but to radio receivers, television, radar, photo-electric units, rectifiers, phonographs, hearing aids and other devices comprising this entire field.

Let's take a quick look at these two words.

"Radionics" springs from the Latin "to radiate" and the Greek "ion" (to wander or travel) and thus we get the term "wandering or traveling radiations," which is much to the point and extremely descriptive.

The first syllable of "electric," "electricity," "electronics," springs from the Greek root meaning "amber," which they discovered had certain properties when rubbed. Therefore I take it electronics is wandering amber. Is that descriptive?

The term "electron," as thought of to-day, is of British origin, having been first used by C. J. Stoney in 1891. Since we did not adopt the British words petrol, underground, bobby, pub, valve and wireless, but instead are using the Americanisms—gasoline, subway, cop, saloon, tube and radio, why should we adopt the word "electronics"?

Incidentally, in the early days of radio, the same confusion existed in the American public mind between radio and wireless as now exists between radionics and electronics.

Even the physicists have said, "Radionics is more descriptive." Dr. Arthur F. Van Dyck, president of the Institute of Radio Engineers, said at the Chicago annual dinner of the institute on December 18 last: "Recently I heard a term for these new radio fields which seems apt. It is 'radionics.' That seems to be

a good term if we want to find one which will win friends and influence people."

My point is, we have a good American word in "radionics," highly descriptive, looked upon with favor by engineers and physicists, and easily understood by the general public. A word that, in my opinion, is fit to describe the miracles now being wrought behind the secret panels of radionic laboratories—wrought for the winning of the war. A word that includes the entire field of radar, electronics and radio in one covering term.

Over the long distance telephone in the past few days I have talked with most of the leaders of the industry, and of the two terms all of them seem to feel the American term "radionics" is more descriptive and will be less confusing to the public.

For the sake of our entire industry I would be deeply interested in the reaction of the press. May I have your opinion?

E. F. McDONALD, JR.

MAKING MOSQUITO SURVEYS WITH A JEEP AND THE PBY-5

THE Patrol Bomber (PBY-5) and particularly the Jeep have been found indispensable in carrying out mosquito survey work at the U. S. Naval Air Training Center near Corpus Christi, Texas.

The success of the Jeep lies in its ability to go anywhere. She can wade through water that covers the floor boards, or scoot through brush that is higher than the car. Her four-wheel drive mechanism pulls her over sand dunes or through axle-deep mud. Throughout the design of the Jeep all waste space has been eliminated, but two men with collecting and camping equipment can successfully live out of her for days. Many successful reconnoitering survey trips have been made that included four individuals.

For the preparation of the survey map, it was found that a drawing board measuring 20×36 inches could be built into the rear seat. Each end of the board rests on the fender frames. A piece of 2×4 or 2×6 board is attached to the under side of the drawing board where it not only acts as a stop to keep the board from shifting, but raises it up to a more desirable level for drawing. Drawing paper can then be thumb-tacked to the board or sealed with decorator's self-sealing tape.

This type of arrangement has worked successfully in the preparation of maps in which the scale has been 2 or 4 inches equal to 1 mile. Thus, by means of the speedometer readings, compass, protractor and ruler, the location of the ponds, lakes, marshes, roads, creeks, etc., can be accurately plotted. It was found that there was no incorrect degree of deviation of the compass when it was held in the center of the drawing board. The mosquito breeding places have been located and plotted in an area of over 100 square miles in less than a week by the use of this method.

At many times, it is desirable to see the extent of the mosquito breeding area from the air, and for this the PBY-5 has been most frequently used. This ship is equipped with so-called "glass blisters" in the fuselage. This has the advantage of permitting one to see the ground in all directions. The PBY-5 is capable of flying at low speeds and from an altitude of 100 feet, detailed examination of the ground can be made and sketch maps prepared.

WILLIAM M. GORDON

U. S. NAVAL AIR STATION,
CORPUS CHRISTI, TEXAS

DR. A. W. GRABAU IN CHINA

THE following communication from Mrs. Amadeus W. Grabau (Mary Antin) will be of interest to many geologists. Dr. Grabau, who has long been engaged in paleontological work for the Chinese government, is still living in Peking.

In November I received a very short letter dated August 4, 1942, in my husband's own hand. He stated briefly that he and his household were getting along tolerably well with the help of a subsistence allowance from our State Department which, as you probably know, all American nationals in enemy territory receive through the nearest Swiss representative. This letter was brought out of Peking by a friend, Dr. A. B. D. Fortuyn, who came out with the first lot of various nationals to be exchanged.

Later I called upon Dr. and Mrs. Fortuyn in New York. They gave me a reassuring picture of my husband. When they last saw him in August (1942), he was in no worse health than he had known for years past and was able to concentrate in his usual energetic fashion on his writing. Publication is of course very doubtful now, but at least there is no interference with his writing. His current secretary-housekeeper, a German lady—one of a succession of refugees whom Dr. Grabau has sheltered in his compound from time to time—seemed to be efficient and devoted. Some of his Chinese friends are still at hand to look after him as in years past. Also Dr. Hoeppli, formerly on the staff of Peking Union Medical College, now representing the Swiss government to look after American citizens in Peking, is well acquainted with my husband and sure to look after him.

General conditions in Peking were not too bad. The food situation was tolerable as of early August. American citizens, with the exception of two or three administrative officers of P.U.M.C., had the freedom of the city and were carrying on pretty much as in former days. My husband was left undisturbed in his own compound with a sufficient domestic staff.

A significant item was relayed to me by Dr. Roger S. Greene. In a news letter from Chungking dated November 10, 1942, was the following reference to my husband: "Professor Grabau has been given $6.00 local currency a month by the Japanese in token of their recognition

and appreciation of his scientific contribution to the theory of Pulsation."

In the opinion of Dr. and Mrs. Fortuyn, my husband would not be able to make the journey under present traveling conditions, if he were offered the opportunity to be exchanged.

HERVEY W. SHIMER
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SCIENTIFIC BOOKS

TEXT-BOOKS OF PHYSICS

A Laboratory Manual of Experiments in Physics. By L. R. INGERSOLL and M. J. MARTIN. 5th edition. xi + 342 pp. McGraw-Hill Book Company. 1942. $2.50.

General Physics for the Laboratory. By L. W. TAYLOR, W. W. WATSON and C. E. HOWE. Revised edition. vii + 184 pp. + 107 record sheets. Ginn and Co. 1942. $2.00.

A Laboratory Manual of Electricity and Magnetism. By LEONARD L. LOEB. Revised edition. xii + 121 pp. + experiment data sheets. Stanford University Press. 1941. $1.90.

University Physics, Part III, Light. By F. C. CHAMPION. 172 pp. London and Glasgow: Blackie and Son, Ltd. New York: Interscience Publishers, Inc. 1941. $1.50.

College Physics. By A. W. DUFF and MORTON MASIUS. x + 588 pp. Longmans, Green and Co., Inc. 1941. $3.80.

College Physics. By HENRY A. PERKINS. Revised edition. xi + 802 pp. Prentice-Hall, Inc. 1943. $4.50.

A Survey of Physics for College Students. By FREDERICK A. SAUNDERS. Third edition. xii + 724 pp. Henry Holt and Co., Inc. 1943. $4.00.

Physics. By FRANK L. ROBESON. ix + 819 pp. The Macmillan Company. 1942. $4.50.

Introduction to Physics. By HARLEY HOWE. xii + 559 pp. The McGraw-Hill Book Company. 1942. $3.75.

Analytical Experimental Physics. By H. B. LEMON and MICHAEL FERENCE, JR. xvi + 584 pp. 66 plates. 584 zincs. University of Chicago Press. 1943. $7.00.

THE first three books on the list are laboratory manuals of real merit.

Ingersoll's "Experiments" appeared in a modest first edition almost two decades ago. It established a clientele. Professor Martin joined in preparing the third edition. Through successive editions the manual has been enlarged and enriched and now ranks with the best available.

"Taylor, Watson and Howe" appears in a revised edition after sixteen years of successful use. New experiments have been added; old ones have been brought up-to-date. The M-K-S units are now used throughout. One hundred and seven pages of "Record Sheets" have been added. These innovations will encounter warm friends and ardent foes.

For years the reviewer has recommended a short list of "manuals" to his pupils in general physics. "Ingersoll and Martin" and "Taylor, Watson and Howe" have been on the list. Could not an effective course in general physics be offered with a manual like either of these, perhaps reshaped a little, as the core text-book with a shelf of the usual texts in general physics at hand for collateral reading?

Professor Loeb's "Manual of Electricity and Magnetism" presents in 120 pages twelve admirable experiments chosen to supplement the author's course, each presented in great detail. There follow at least 200 pages of "Experiment Data Sheets." The treatment follows conservative and classical lines proceeding from magnets and magnetic fields to current, potential difference, resistance and so on.

The "soul of the book" is revealed in its twelve pages of "preface" and "announcement." The reviewer pauses to salute the loyal teacher who wrote them. The manual has been written, says the author, in an attempt "to put into practice certain ideals of laboratory instruction gleaned from his years as a student teacher." The author proposes so to plan and to conduct his laboratory instruction that the work of his pupils will automatically rise to a high level of laboratory ethics. May the author's kind increase! And may his ideals motivate all instruction everywhere!

Up from mighty London comes Part III, "Light," of Professor Champion's "University Physics." Packed into thirteen chapters and 172 pages are the essentials of optics. Numerous illustrations, well drawn and aptly chosen, illuminate the text. Questions and numerical exercises follow each chapter. A list of seventy-five examples closes the book. This text should receive serious consideration for a one-semester course at the second-course level.

The rest of the books, six in all, are texts for the general college course. Each author has written the "Thing as he sees it for the God of Things as They Are," for teachers as they are and for students as they are supposed to be. What an array of boundary conditions! Small wonder that the solutions are so varied.

Perhaps never before have texts been so critically scrutinized, for are not most of these on the list of texts recommended for the "basic courses" of the

Army and Navy? Thousands and tens of thousands of young men who neglected to conquer General Physics while in civilian clothes must now face him in uniform in preparation for encounters with foes that are still more formidable.

None but the oldest oldsters can recall the days before there was a "Duff's Physics." And it now seems altogether likely that youngsters yet unborn will study "Duff" in their turn. Let's create a list of the perennial texts with Duff's "Physics" at the top. Its lucidity, thoroughness, meticulous accuracy and usableness have been recognized for decades. And now Professor Masius joins Professor Duff in a revision of Duff's "College Physics." "Vitai lampada tradunt."

Perkins's "College Physics" has gone through six printings and an "abridged edition" in five years, and now is issued as a revision. The author has been alert to opportunities to improve his original text. New problems, without answers, have been added to match the original ones, with answers, which are retained. New topics have been added, and some old topics have been rewritten. The claims that the book is meaty, thorough, sound, conservative and attractively written are in accord with the reviewer's personal experience in using it. For instance, compare Perkins's treatment of "Waves" with run-of-the-mine treatments. This book has earned a place for itself.

Saunders's "Survey of Physics" has been in use for thirteen years. The third edition has just appeared.

One envies the student who uses this text. One reads, and reads on, just for the joy of reading English that says things so frankly and clearly, so convincingly, so attractively—even humorously at times. The illustrations are right to the point. And the paragraphs in fine print present interesting topics, such as: "the fission of uranium," "the ultra-red telescope," "theories of magnetism," "Foucault's pendulum." The recommended reading includes the old classics and the latest word—"Heat as Mode of Motion" and "Phenomena at the Temperature of Liquid Helium"—side by side.

The M-K-S system is put in fine print as a proposal of merit and promise, to be learned along with the other systems.

He who masters this "Survey" learns a lot of solid, live and growing physics.

Robeson's "Physics" and Howe's "Introduction to Physics" made their bows during the past year. A preliminary examination of both books reveals all the signs of texts well written. All the old familiar landmarks are preserved, and the new find their places among the old. As in Duff and Masius and in Perkins and in Saunders the M-K-S system is recognized and is given its place. It supplants nothing. Time only will decide the place it will occupy. Both Robeson and Howe are to be commended for many original and striking ways of presenting old concepts and familiar principles. The reviewer could use either text with confidence.

For the reception of Lemon and Ference's "Analytical Experimental Physics" the reviewer's mind had been conditioned by "From Galileo to Cosmic Rays" and by "Cosmic Rays so Far." Imagine then his surprise when handed five pounds, 250 cubic inches and seven dollars worth of book! And between the covers one finds good straightforward physics, at an advanced undergraduate level, set forth with unusual clarity in great detail and beautifully illustrated with diagrams, photographs and strips from motion picture films. This book invites perusal. It promises to be worth all that it costs, all the space that it occupies, and all the effort required to lift it and carry it.

For some years past consistent effort has been made at the University of Chicago to bring the students into more intimate contact with physical phenomena by the use of moving pictures and of the demonstration laboratory. And now the moving pictures and the demonstration laboratory have been put, in part at least, between the covers of a book.

When the reader opens Lemon and Ference he steps into the presence of the phenomena, and on the printed page he reads the language, the equations and the graphs that men employ when thinking and speaking about the phenomena. Has there not appeared a new and a significant development of the art of writing text-books?

THOMAS D. COPE
UNIVERSITY OF PENNSYLVANIA

MAN AND HIS PHYSICAL WORLD

Man and His Physical World. By DWIGHT E. GRAY. Van Nostrand, 1942. 665 pp. $3.75.

THIS is a remarkable book. If I had to describe it in a single phrase, I should say that the author has managed to be encyclopaedic without being ponderous, no mean achievement! The mere scope of the book is startling. I can give a notion thereof in no better way than by listing the chapter-titles, numerous as they are: Science and the Scientific Method—The Solar System—The Universe Beyond the Solar System—Astronomical Measurements—The Earth as an Astronomical Body—Factors Which Change the Surface of the Earth—Clues to Earth History—Geological History—Numbers and Number Systems—Units of Measurement—The Nature of Matter—Air and Water—Fuels—Metals and Alloys—Colloids and Rubber—Synthetics—Force, Work and Power—Energy and Its Transformations—Heat Engines—Magnetism—Static Electricity—Current Electricity—Electricity

and the Atom—Wave Motion—Sound—Light—Communication — Illumination — Refrigeration. Such a book would be expected to proceed from the conjoined efforts of many professors, or if from one, then from the occupant of a chair in General Science and Engineering or in "Natural Philosophy" of the eighteenth-century sense. Mr. Gray is designated as an Associate Professor of Physics (in the University of Akron) but I suspect and hope that his lectures range over a wider field.

The style is conversational, at times even chatty, with flashes of humor. Among the sections which I found most readable are the chapters on the solar system, the passages on the atmosphere and on weather (tucked away in the chapter oddly entitled "Factors Which Change the Surface of the Earth"), the chapters on fuels, on alloys and on synthetics including plastics, and that entitled "Heat Engines" and devoted largely to the automobile. Another reader would probably make another selection, depending upon the distribution of his interests and of his ignorances: it would be difficult to find a reviewer capable of making an impartial judgment, for he would have to bring an equal interest and an equal state of knowledge to every subject, and probably no such person exists.

There is a rather depressing joke to the effect that an encyclopaedia is a book of which one likes the treatment of every subject except one's own. The errors which I find in the treatment of physics do not vitiate the book, but they do suggest that in the to-be-hoped-for second edition each part should be submitted to the inspection of a narrower expert. Cohesive forces between molecules do *not* vary inversely as the square of the distance; a liquid may be denser than the solid into which it freezes; the constituents of a mixture do not boil off individually and completely at the respective temperatures at which they would boil if pure; Franklin's kite experiment is now regarded by the historians as a myth; the reason given for believing that e/m is the same for all electrons is not a valid reason; the nuclear atom-model was invented by Rutherford and also by Nagaoka, but not by Bohr; there are several natural radioactive substances lighter than lead, and *all* elements can be obtained in radioactive forms, not "just a few." I could go on like this, but do not wish to leave the impression that the flaws are more numerous than the right statements, a danger which reviewers often incur. The difficulty is that correct statements are not news.

Some passages which I marked for favorable quotation are: the very timely reference to the 1886 Commissioner of Labor who stated "in his annual report that . . . the next fifty years would see no such advance as the previous half century"; the clever definition of plastics, including the phrase "only man can make a plastic"; the definition of force in the words: "Our purposes in this discussion will be adequately served if we define force simply as 'push or pull.' The fact that the definition contains only words of one syllable may keep it from sounding very impressive, but it covers the ground satisfactorily." And again: "An individual whom we describe as having a great deal of energy is one whom we think of as being able to accomplish a lot. Very much the same idea is involved in the scientific definition which states 'Energy is the capacity for doing work.'" And to terminate: "Radio-active disintegration is somewhat as though a large brick factory building should shoot out a lot of bricks and become a theater, which after a time would emit more bricks and settle down into a dwelling-house, which later on would repeat the procedure and continue its existence as a hamburg stand."

I hope that these remarks and quotations will entice many to read this book. It remains to be said that there are many striking photographs, and that for the benefit of those who wish to test their absorptive powers and their memories the author has supplied after each of the chapters a multitude of questions, classified as "Discussion," "Multiple-Choice," and "True-False."

KARL K. DARROW

SOCIETIES AND MEETINGS

THE KANSAS ACADEMY OF SCIENCE

THE seventy-fifth annual meeting of the Kansas Academy of Science was held at Lawrence, Kansas, on April 10, with Dr. Raymond H. Wheeler, University of Kansas, Lawrence, Kansas, presiding. The affiliated society, The Kansas Entomological Society, met with the Academy. Other state societies which held their meetings in cooperation with the Academy were The Kansas Association of Teachers of Mathematics and the Kansas Chapter of The Mathematical Association of America.

This was the Diamond Jubilee Meeting of the society, the first meeting having been held in 1868. Originally it had been the intention to celebrate this milestone along the lines of the Golden Anniversary held in Lawrence in 1918, but such plans were abandoned and this meeting, shortened to one day, was conducted in a conservative manner. The goal was a vigorous, effective meeting to maintain the virility of the organization without handicap to the war effort.

During the morning, section meetings were held for Biology Teachers, Botany, Chemistry, Geology,

Physics, Psychology and Zoology. No attempt was made to hold a section of the Junior Academy but local chapters had been encouraged to hold meetings at which the outstanding demonstrations, papers and exhibits were selected. These were brought to the state meeting and judged.

Saturday afternoon was devoted to a symposium on "Science and the War Effort," in which nine persons qualified to represent their respective fields, related the activities of that field to the war. The following fields were represented: Agriculture by Dean L. E. Call, Kansas State College; Bacteriology and Medicine by Dr. Noble P. Sherwood, University of Kansas; Botany by Dr. Paul B. Sears, Oberlin College; Chemistry by Dr. John W. Greene, Kansas State College; Entomology by Dr. H. B. Hungerford, University of Kansas; Geology by Dr. John C. Frye and C. Philip Kaiser, State Geological Survey; Physics by Dr. J. Howard McMillen, Kansas State College; Psychology by Dr. H. B. Reed, Fort Hays Kansas State College; Zoology by Dr. John Breukelman, Kansas State Teachers College, Emporia. The society plans to publish these talks in the current volume of its Transactions.

The Constitution was amended to add two sections. The first decreed that the Academy shall have a librarian to be elected annually; the second that the chairman of the Junior Academy of Science shall be elected for a period of three years and be a member of the Executive Council.

The annual banquet was held on Saturday evening, President Harvey A. Zinszer presiding as toastmaster. The address of welcome was given by Chancellor Deane W. Malott of the University of Kansas. A program in keeping with the spirit of the meeting was conducted. Dr. E. S. Riggs, formerly of the Field Museum of Natural History, an honorary member, gave a word of congratulation to the society from this group; and greetings were voiced by Dr. Julius T. Willard, formerly dean of science at Kansas State College, for the life members. The secretary read the names of 20 persons who had been annual members for 20 years or more that had been elected to life membership to commemorate this milestone in the history of the society. Many of these persons were present at the banquet. Dr. Raymond H. Wheeler, the retiring president, read numerous messages from older life members who were unable to be present and then gave the address of the retiring president entitled, "Climate and Human Behavior History."

The banquet was followed by the annual public meeting. The program for this occasion consisted of an invitational address by Dr. Paul B. Sears, head of the department of botany of Oberlin College, and a noted ecologist. His subject was, "The Ecology of Peace." It was a timely discourse at this stage of our war torn world.

TABLE I

SECTION RECORD, WITH PAST AND FUTURE OFFICERS—LAWRENCE MEETING

Name of section	Chairman for 1943	No. papers on program	No. persons attending	Chairman for 1944
Biology Teachers	Sherwin B. Griswold	4	15	J. Ralph Wells
Botany	Andrew Riegel	15	30	S. M. Pady
Chemistry	J. Wilbert Chappell	13	45	Worth A. Fletcher
Geology	H. T. U. Smith	10	15	W. H. Schoewe
Kansas Entomological Society	H. B. Hungerford	9	35	Robert Bugbee
Kansas Chapter of Math. Assoc. of Am.	C. F. Lewis	9	55	Paul Eberhart
Kansas Assoc. of Teachers of Math.	Daniel B. Pease	9	55	H. H. Bishop
Physics	W. D. Bemmels	8	26	C. V. Kent
Psychology	O. W. Alm	11	32	Maurice C. Moggie
Zoology	Jacob Uhrich	17	34	Dorothea S. Franzen

The Academy registration was 185. The reports from the section chairmen on their sections is presented herewith in Table I.

The next annual meeting of the Academy will be held at the Washburn Municipal University of Topeka if plans can be perfected to that end; otherwise at Kansas State College, Manhattan, Kansas.

The following officers were elected for the next year and meeting: President, Harvey A. Zinszer, Fort Hays Kansas State College; President-elect, L. D. Bushnell, Kansas State College; Vice-president, John W. Breukelman, Kansas State Teachers College, Emporia; Secretary, John C. Frazier, Kansas State College; Treasurer, F. W. Albertson, Fort Hays Kansas State College; additional Executive Council members, R. H. Wheeler, University of Kansas; Claude Hibbard, University of Kansas; A. C. Carpenter, Ottawa; and Edith Beach, High School, Lawrence. W. J. Baumgartner of the University of Kansas was re-elected Managing Editor of the *Transactions* for a period of three years. Paul Murphy of K.S.T.C., Pittsburg, was elected an Associate Editor for a term of three years. Roger C. Smith of Kansas State College was re-elected as delegate to the academy conference for one year. Donald J. Ameel of Kansas State College was re-elected Librarian. Miss Edith Beach of Lawrence High School was elected secretary of the Junior Academy for a three year term.

JOHN C. FRAZIER,
Secretary

MANHATTAN, KANSAS

PENNSYLVANIA ACADEMY OF SCIENCE

THE regular spring meeting of the Pennsylvania Academy of Science was held in Harrisburg on April 2 and 3. Because of the emergency, the usual evening dinner was omitted and the session curtailed. Nevertheless, about 200 persons attended. The evening of the second was opened with papers by Dr. William L. Rhein and Dr. John M. Fogg, Jr., on natural history, particularly as applied in Pennsylvania. On the third, the customary procedure was changed. Instead of the reading of many papers by the members, a few selected papers were read which in their entirety were in the nature of a symposium on research and the status of science education. President Charles E. Mohr presided. The following officers were elected: *President,* C. A. Horn; *President-elect,* Homer C. Will; *Vice-presidents,* Bradford Willard and Leroy K. Henry; *Editor,* E. M. Gress; *Secretary-Treasurer,* V. Earl Light; for the Junior Academy, Mary E. Hawthorne.

BRADFORD WILLARD

SPECIAL ARTICLES

THE CULTIVATION FROM GRANULOMA INGUINALE OF A MICROORGANISM HAVING THE CHARACTERISTICS OF DONOVAN BODIES IN THE YOLK SAC OF CHICK EMBRYOS[1]

IN spite of careful work by a number of investigators no agent acceptable as the etiologic factor of granuloma inguinale has as yet been cultivated. Recent reports by Dienst, Greenblatt and Sanderson,[2] by Greenblatt, Dienst, Pund and Torpin[3] and by Carter, Jones and Thomas[4] agree that the agent is not cultivable on a wide variety of media known to be useful for the cultivation of certain fastidious pathogenic microorganisms. Ordinary experimental animals are resistant to infectious material from natural lesions. Neither of the above groups of workers was able to cultivate the agent on the chorioallantois of chick embryos. Greenblatt and his associates were able to reproduce the infection in human beings with material containing Donovan bodies apparently free from contaminants. They concluded that the Donovan body is the etiologic agent, that it is not related to the Friedlander-aerogenes group of bacteria and has not been propagated outside the human body.

This paper reports the cultivation in the yolk sac of living chick embryos of a microorganism that has all the morphological characteristics of the Donovan organism and is as yet neither cultivable on ordinary culture media nor pathogenic for mice, dogs or monkeys.

Tissue from a human lesion especially rich in Donovan bodies and with remarkably little evidence by smear of contamination with bacteria was obtained by Dr. W. A. DeMonbreun from a patient at the Nashville General Hospital. Small bits of this tissue were smeared over the surface of cystine agar slants subsequently incubated at 37° C. After 96 hours two slants appeared free of any bacterial growth. Smears showed the presence of a few gram-negative bipolar forms seemingly closely associated with degenerating tissue. These microorganisms appeared to be viable. There was little or no evidence that they had multiplied on the slant. They were not unlike non-encapsulated Gram-negative forms characteristically associated with Donovan bodies in granuloma inguinale lesions.

Each uncontaminated cystine slant was washed with 3 cc .85 per cent. NaCl; the washings were pooled and .5 cc was inoculated into the yolk of six 8-day-old embryos. On the third day two embryos, dead without evidence of bacterial growth, were discarded. Smear from the yolk of one live embryo at this time did not show evidence of bacterial growth. On the eighth day smears from the yolk of each of the four remaining living embryos, stained with Wright's and Gram's stains, revealed the presence in abundance of both encapsulated and non-encapsulated Gram-negative microorganisms indistinguishable from Donovan bodies and from those pleomorphic Gram-negative non-encapsulated forms always present in lesions of granuloma inguinale.

Subcultures of the microorganism present on the original cystine slants to other cystine slants did not grow. The microorganism present in the yolk sac of embryos has repeatedly failed to grow on enriched blood media, potato-dextrose-agar, anaerobic broths and meat, Loeffler's slants and egg-yolk slants.

As far as we could determine these original yolk sac cultures were pure and the microorganism has been uninterruptedly and easily cultivable in the yolk sacs of living chick embryos through 25 successive passages during a period of three months.

Transfers have been made by drawing infected yolk from its sac with a needle and syringe and injection

[1] This work was aided by a grant from the John and Mary R. Markle Foundation.

[2] R. B. Dienst, R. B. Greenblatt and E. S. Sanderson, *Jour. Infect. Dis.*, 62: 112–114, 1938.

[3] R. B. Greenblatt, R. B. Dienst, E. R. Pund and Richard Torpin, *Jour. Am. Med. Asn.*, 113: 1109–1116, 1939.

[4] Baynard Carter, C. P. Jones and W. L. Thomas, *Jour. Infect Dis.*, 64: 314–316, 1939.

of .2 to .5 cc into the yolk sacs of other embryos. Embryos of various ages were used and transfers were made at various intervals following inoculation.

The morphology of the microorganism varies depending somewhat more upon the age of the embryo from which the smear is made than upon the duration of the infectious process. Cultures from early generations showed mixtures of encapsulated and nonencapsulated forms. As passages increased smears from older embryos showed predominantly unencapsulated forms while smears from young embryos showed a predominance of encapsulated ones. Experience has determined that inoculation of 5- or 6-day embryos into the yolk yields consistently in 72 hours a rich culture that is almost wholly encapsulated. The encapsulated form has been maintained in series. This form inoculated into 12-day embryos grows out largely unencapsulated. Embryos from 1-through 13-days incubation support subsequent development of infection following inoculation into the yolk sac. Our experience indicates that the yolk of every embryo inoculated (700–800) has yielded a growing culture.

This microorganism grows evidently extracellularly in the yolk of the embryo. Smears and histological sections also show that it occurs both in its encapsulated and unencapsulated form inside epithelial cells of the yolk sac membrane, also within mononuclear cells of inflammatory exudate in the yolk and its sac. Notwithstanding direct inoculation evidence that it grows on the chorioallantois or invades the embryo proper from the yolk sac is as yet lacking. Inoculation into the amniotic fluid of the intact embryo seems to support growth feebly.

Infected yolk of the 10th passage was drawn from the embryo and stored in sealed test tubes at 5° C, 25° C, 37° C and at −78° C. After 17 days stored yolk from the first three groups was diluted 50 per cent. with .85 per cent. NaCl and injected in .5 cc amounts into 6-day yolk sacs. That stored at 25° C grew out promptly in 72 hours; that stored at 5° C and at 37° C grew slowly, but all embryos showed a good growth at the end of a week. Similar tests for survival made at the end of 33 days showed that the microorganism survived only at 25° C. Yolk stored at −78° C has not yet been tested for survival of the organism.

Mice inoculated intraperitoneally showed no evidence of infection. Dogs inoculated intra- and subcutaneously have not yet shown evidence of infection. *Macacus rhesus* monkeys were inoculated intra- and sub-dermally. Organisms resembling Donovan microorganisms were demonstrated by smears from nodules that persisted for 4 days, but the nodules regressed and have shown no further activity.

The fact that the microorganism appeared to grow in the yolk of the intact developing embryo made its culture in that medium *in vitro* seem feasible. Yolk alone from uninfected 5- and 6-day embryos in test-tubes did not support growth, but with the addition of bits of embryonic chick heart it gave a fairly good culture in 6 days at 37° C. After 2 serial passages in yolk-heart medium a subculture in yolk without heart was initiated. Strains have thus been maintained through ten serial passages *in vitro* during 7 weeks in yolk with and without heart.

Experiments are in progress at the present time to determine the relationship of this microorganism to the human infection, granuloma inguinale. A series of experiments to determine something of its antigenic relation to the disease is also being carried out. More detailed consideration of its morphological, cultural, antigenic and pathogenic characteristics will be the subject of further study.

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EFFECTIVENESS OF VITAMIN A IN THE TREATMENT OF DEFECTIVE COLOR VISION

SEVERAL reports have appeared in this journal durin the past year on problems of color-blindness, tests for color sensitivity and the value of vitamin A as a remedial agent in conditions of defective color perception.[1,2,3,4] The first suggestion that vitamin A could be used with effect in cases of impaired sensitivity to color was made in a report by Dunlap and Loken[5] before the Southern Society for Philosophy and Psychology. This was followed by the statement that cases were "cleared up" with vitamin A in from three to eight weeks, using doses of 25,000 units per day.[1] Later, these writers stated that 80 per cent. of their cases were able, after vitamin A treatment, to pass chart tests which they had failed previously.[3]

The practical importance of color vision has increased greatly since the beginning of the war. With well over a million men of draft age showing some degree of color deficiency, the possibility of salvaging even a small percentage of this man-power for the armed services or for vital work in industry was certain to attract attention.

Present knowledge of function of the visual receptors, plus the fact of a demonstrable hereditary

[1] K. Dunlap and R. D. Loken, SCIENCE, 95: 2474, 554, May 29, 1942.
[2] E. MURRAY, SCIENCE, 96: 2484, 133–5, August 7, 1942.
[3] K. Dunlap and R. D. Loken, SCIENCE, 96: 2489, 251–2, September 11, 1942.
[4] E. MURRAY, SCIENCE, 96: 2498, 448, November 13, 1942.
[5] K. Dunlap and R. D. Loken, *Psychol. Bull.*, 39: 585, October, 1942.

determinant and a tendency for color thresholds to remain constant under varied environmental conditions, indicated that the defect probably would not respond to vitamin treatment. However, until just ten years ago, we were not fully aware of the intimate and essential role of vitamin A in the normal function of the rods. The discovery of the relationship between vitamin A and rhodopsin could suggest that it might also be required in some similar but unknown way by the cones.

Following the first report by Dunlap and Loken, some preliminary observations were made on 16 college students who had defective color vision. Most of them had failed to pass tests of the Army Air Corps, but were quite anxious to do so. Three tests were used with this group: the Ishihara, the American Optical Company's pseudoisochromatic plates and the Westcott lantern slide, which is a modification of the yarn test principle for the purpose of group testing. Vitamin A (as purchased locally in the form of concentrated fish oil) was given to these subjects in doses of 25,000 units daily for eight weeks or more. One of this group took 250,000 units daily on prescription of a local physician. Fourteen of these cases, including the one just mentioned, showed no improvement, but two of them finally achieved almost perfect scores. Both of these subjects subsequently passed the Army Air Corps tests and are now training in that service.

Had all these preliminary tests been negative, it is unlikely that further observations would have been made, but it seemed difficult at the time to account for the improved performance of these two individuals except as being a result of vitamin A treatment. In the light of the results reported below, it may be necessary to accept another hypothesis. It should be said, however, that the original defect in these two cases was of slight degree.

In order to check the possibility that some benefit could be derived from vitamin A by a few individuals, some extensive observations were made under more rigid conditions. Group tests of 897 R.O.T.C. freshman cadets at Louisiana State University showed 65 who had various degrees of weakness in color sensitivity. Individual tests were then given to 58 subjects who began taking 50,000 units of vitamin A on alternate days. This schedule was continued for eight weeks. After having taken 1,400,000 units, each subject was retested under the same conditions as before.

Because there are many reasons why subjects, especially those who are not volunteers, might fail to follow instructions for taking vitamin A, it was considered important that this part of the test be carefully supervised. Accordingly, the subjects were required to swallow the capsules at regular hours at a dispensing station.

No significant improvement in color sensitivity was shown by any individual in the group of 41 who finished the eight weeks period of treatment. Most of the records of response to the 62 plates of the American Optical and Ishihara tests were practically identical before and after taking vitamin A. The maximum improvement shown by any individual was a correction of three previous errors. The lantern slide test gave essentially the same results, although there was more variability in the responses. An analysis of the reliability of these tests and their value as a convenient means of detecting color "blindness" will be presented in a later report.

The procedure in the present experiment differed from that of Dunlap and Loken in a few respects. We used a large number of subjects of approximately the same age (median, 17 years, 9 months) and living under very similar conditions throughout the period of testing. We are able to assert positively that all subjects actually took vitamin A, because this was done regularly in the presence of the experimenter or an associate. The material used was a vitamin A ester of high potency, determined spectrographically and confirmed by bio-assay.

It may be concluded from these tests that vitamin A in doses of 25,000 I.U. daily for eight weeks fails to produce any significant improvement in color sensitivity. It seems improbable that administration of the vitamin for longer periods of time would change this result, although observations are being continued on several subjects.

Murray[4] warns against the unfortunate consequences which could follow acceptance of vitamin cures for color deficiency until the permanency of results is thoroughly tested. The present study does not entirely dispose of the possibility that a few men, perhaps with minor color vision defects, may improve slightly; but the number who could use vitamin A for this purpose is so small as to be negligible. We need not, therefore, be concerned about the numbers who can pass the test temporarily.

The writer wishes to acknowledge his appreciation to Colonel George F. N. Dailey for his cooperation in the group testing of cadets and to the Norwich Pharmacal Company for its contribution of the vitamin A.

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VITAMINS IN DEHYDRATED SEEDS AND SPROUTS

THE common use of sprouted seeds in the diets of oriental peoples appears to rest on a sound nutritional basis, if we are to judge by the vitamin content of such food materials. It has already been reported that significant increases in the concentration of riboflavin, nicotinic acid and biotin occur during germination of

many kinds of edible seeds.[1] Wheat and barley show increases of thiamine during germination, but several other species appear not to change appreciably in vitamin B_1 content. The present brief report summarizes certain earlier data obtained on cereals, and presents some new observations for pantothenic acid, pyridoxine, folic acid and inositol in seeds and sprouts of several common species of edible plants.

The general methods of investigation which were reported earlier have been continued in this work. Seeds were germinated at 25° C in a greenhouse or in peat moss and after 5 or 6 days the whole plants, including seed, shoot and root, were harvested, washed clean and dehydrated at 70° C. The dormant seeds were dried in a similar manner. All dried samples were ground in a small Wiley mill, and aliquots were taken for assays. For determinations of pantothenic acid, pyridoxine, folic acid and inositol, 0.5 gm of dry material was placed in 30 ml of buffer solution at pH 4.5. The buffer solution contained 3.75 gm glacial acetic acid and 5.0 gm anhydrous sodium acetate per liter. Twenty milligrams of papain and 20 mg of Taka-diastase were added to each half gram sample, and the mixture was incubated at 37° C for 24 hours. A few drops of benzene were used to inhibit growth of microorganisms. The digested material was heated in steam at 100° C for 30 minutes, made up to a volume of 50 ml, filtered with Super-cel in a Büchner funnel and subsequently extracted twice with ether. The filtration and ether extraction were adopted for the purpose of removing fatty substances which might have interfered with the microbiological assays.[2] Pyridoxine was assayed with a yeast growth method according to a procedure developed in the Yale laboratories.[3] The other vitamins were tested in accordance with methods published by R. J. Williams *et al.*[4] The losses in dry matter which occurred during germination were determined for the purpose of making certain calculations regarding the change in vitamin content. Vitamin values of the plant materials were corrected for errors introduced by the presence of small amounts of vitamins in the enzyme preparations.

A summary of the data obtained for four kinds of plants is presented in Table I. The ratio of dry matter in the dormant seeds to that found in 6-day-old sprouted seeds ranged in the different species from 1.06 to 1.33, indicating some loss in dry material in metabolic processes accompanying germination. The vitamins expressed as micrograms per gram of dry matter, show much greater gains in sprouting seeds than can be accounted for on the basis of increased concentration through loss of dry matter and mere maintenance of vitamins stored in the seeds. The data presented for riboflavin, nicotinic acid, biotin and thiamine are averages taken from experimental work reported in a previous paper. The observations on pantothenic acid, pyridoxine, folic acid and inositol, reported here for the first time, offer further evidence for the increase of vitamins during germination. It appears also that considerable differences in content of these vitamins exist among species. In addition to the kinds of plants listed in the table, certain others were also studied. Germinated peas and buckwheat showed gains in pyridoxine and folic acid ranging from 3 to 10 fold and smaller increases in pantothenic acid.

It seems probable that not all species may be expected to exhibit such increases in vitamin content as are indicated for the sprouting cereals. It would be desirable to have these preliminary determinations, which are based entirely upon microbiological assays, checked with other methods. The data obtained thus

TABLE I

VITAMIN CONTENT OF DORMANT AND SPROUTED SEEDS. MICROGRAMS PER GRAM OF DRY MATTER*

	Oats		Wheat		Barley		Corn	
	Dormant	Germinated	Dormant	Germinated	Dormant	Germinated	Dormant	Germinated
Dry matter mg per seed	19.3	14.8	28.5	21.4	35.6	30.2	315.0	271.3
Riboflavin	0.8	11.6	1.3	5.4	0.9	7.2	1.1	4.3
Nicotinic acid	7.5	44.0	62.0	103.0	67.5	115.0	9.5	39.5
Biotin	0.9	1.4	0.17	0.36	0.31	0.91	0.21	0.54
Pantothenic acid	7.6	21.9	7.6	12.6	5.4	10.0	4.2	7.7
Pyridoxine	0.3	1.8	2.6	4.6	0.2	0.5	0.7	0.8
Folic acid	22.0	143.0	28.0	106.0	14.5	50.0	10.0	45.0
Inositol	630.0	1290.0	1460.0	2100.0	1240.0	1370.0	800.0	1640.0
Thiamine	11.3	12.2	7.0	9.0	6.8	9.0	5.5	5.1

*The values are calculated as riboflavin, nicotinic acid, biotin methyl ester, calcium pantothenate, pyridoxine HCl, inositol and thiamine HCl. Folic acid is expressed as micrograms of concentrate having a potency of 3100, according to Dr. R. J. Williams, who so kindly supplied this vitamin material.

[1] Paul R. Burkholder and Ilda McVeigh, *Proc. Nat. Acad Sci., U.S.A.*, 28: 440, 1942.

[2] F. M. Strong and L. E. Carpenter, *Ind. Eng. Chem. Anal. Ed.*, 14: 909, 1942.

[3] Paul R. Burkholder, *Amer. Jour. Bot.*, 30: 206, 1943.

[4] R. J. Williams, University of Texas Publication No. 4237, 7, 1942.

far strongly support the view that many seeds gain in vitamin content during germination. Of considerable importance for animal and human nutrition is the fact that the vitamins which appear to be synthesized in sprouting seeds are preserved during subsequent dehydration.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE CONSTRUCTION OF TISELIUS ELECTROPHORESIS CELLS

INASMUCH as the attention of manufacturers of optical equipment is at present directed almost exclusively toward war production, the procurement of suitable cells for the electrophoresis apparatus of Tiselius has become a rather difficult problem. Because of the wide application of the Tiselius instrument to problems of biological and colloid chemistry it was thought that the experiences of the authors in constructing these cells might prove to be of general interest. The methods should also prove applicable to the construction of other types of glass cells.

The cells have been constructed of one eighth inch thick color-clear plate glass. After a little practice no difficulty was encountered in grinding the glass parts to the proper size on the face of a rotating iron disc fed with carborundum and water in the usual way. The rectangular holes in the horizontal plates were cut by grinding through the faces of the plates from both sides with the edge of a small iron disc mounted in a lathe and fed with carborundum. In this operation the glass was mounted on a plate hinged to the compound tool rest of the lathe. The holes were then squared up by hand with carborundum and a strip of metal. The horizontal sliding surfaces were ground flat on plate glass after the sections were assembled. The center sliding section was of the double length design described by Longsworth, Cannan and MacInnes.[1] It was assembled in two steps. First, the rectangular tubes were cemented and ground on the ends until square and of equal length. During the grinding the tubes were temporarily fastened together with beeswax. Second, the tubes and horizontal plates were assembled and cemented. The top and bottom sections were each cemented in a single operation.

The principal difficulty was, of course, the cementing of the glass parts. Numerous cements of various types were tried without success until a low-melting glass-like material described by von Angerer[2] was used. The cement is made by fusing together 5 parts of washed silicic acid, 16 parts of red lead (minium, Pb_3O_4) and 4 parts of calcined borax, using a blast lamp furnace. While still molten, the material was poured out into water, dried, ground fine in a Mullite mortar and put through a 500-mesh screen. The powder was mixed with water to form a thin paste, which was applied evenly with a brush to the surfaces to be cemented. After the cement dried the parts were assembled in a suitable steel jig, using weights to apply pressure to the joints, placed in an electric muffle furnace, and heated to about 500° C—approximately one hour was required for the furnace to reach this temperature. The proper temperature imparts a slight glow to the furnace, perceptible only in a darkened room. After three hours the furnace was turned off and allowed to cool, about six hours being required for it to reach room temperature. In designing the jig it was found that any metal part which touches the glass over any considerable area should be in contact with the entire glass surface, otherwise the metal conducts heat to local areas and cracks the glass. The joints frequently contain numerous small bubbles, but seem to be essentially as strong as the glass itself. If the cement has been applied evenly a tight seal is obtained.

Although no further polishing of the optical surfaces was attempted, the optical properties of the tubes have been found to be quite satisfactory. No irregularities could be observed in the base lines produced by the cells even though the Tiselius apparatus in use in this laboratory is a rather sensitive one. The joints have been found to be permanent and substantial. Preliminary experiments have indicated that pyrex glass may also be cemented by the same method.

The authors are indebted to William Pabst, Jr., and Julius Pearson, instrument makers at this institute, for helpful suggestions during the course of the work.

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[1] L. G. Longsworth, R. K. Cannan and D. A. MacInnes, *Jour. Am. Chem. Soc.*, 62: 2580, 1940.

[2] Ernst von Angerer, "Technische Kunstgriffe bei physikalischen Untersuchungen," p. 48. Friedr. Vieweg und Sohn, Braunschweig, 1936.

[3] Fellow of the National Research Council.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE COOLING PLANET

SNOWSTORMS of silica once showered down on our cooling planet, and primitive life probably originated in the polar regions, according to Dr. Perley G. Nutting, of the U. S. Geological Survey, writing in the *Journal* of the Washington Academy of Sciences. A planet, starting as a mass of vapor torn from the sun and finally evolving into the present condition of the earth, passes through a number of interesting epochs as its temperature falls.

The dense vapors of a planet at 5,000 degrees Centigrade, which is a reasonable temperature for a planet just drawn from the sun by a passing star, would be subject to rapid cooling by radiation from its outer layers, Dr. Nutting suggests. The body would be violently agitated, as slight cooling would permit combinations of the elements. Such compounds would condense to liquids and fall back as rain to where the temperature was sufficient to vaporize and dissociate them.

When the planet had cooled a thousand degrees, the first liquid core would be formed of liquid iron and iron alloys. At this temperature the atmospheric pressure above the liquid surface was estimated by Dr. Nutting to be as much as 32 tons per square inch, as compared with our present atmospheric pressure of 14.7 pounds per square inch.

The first solids, occurring at 3,000 to 2,500 degrees Centigrade, would probably appear as floating on the liquid sphere. Dr. Nutting suggests that the earth's atmosphere at lower levels consisted mainly of heavy metallic vapors and the vapors of a few stable compounds of high density which would condense at higher levels, rain down, and revaporize. At intermediate and higher levels large quantities of water vapor (as much as 1.85 tons per square inch) would condense and rain downwards, but never reach the surface. At the outer limits of the planet would be cool, free gases.

Silica and silicates in various forms would have been created by the time the planet had cooled to 1,500 to 1,200 degrees. Miles deep, they would cover the old core of the earth and suppress all but a few metallic vapors.

THE DECREASED DEATH RATE IN THE ARMY FROM WOUNDS

AMERICAN physicians are saving from five to nine times as many soldiers from dying of battle wounds in this war as was possible in World War I, it appears from casualty figures reported by Brigadier General Norman T. Kirk, the new Surgeon General of the U. S. Army, at the Chicago meeting of the American Medical Association.

The figures he gave covered the period during the phases of the North African campaign before the Army moved up into northern Tunisia. The death rate at that time in the evacuation hospitals was from 2½ per cent to 3½ per cent, compared to a death rate of 15 per cent. to 18 per cent. in evacuation hospitals in the last war. This remarkably low mortality was achieved in spite of great difficulties in evacuation. In some places eight-mile litter carries were necessary to get the wounded from the field to the ambulances. The ambulances had to travel 20 to 30 miles over mountain roads to evacuation hospitals.

For the future, the Army Medical Department hopes to have exclusive airplanes and possibly even helicopters for the evacuation of the wounded. So far in Africa, 13,000 sick and wounded have been evacuated by plane. But these evacuations were in planes used to take supplies forward. Helicopters are being experimented with but so far none is in actual service for evacuation of wounded.

Plasma, surgery and sulfa drugs were credited in that order for the great saving in lives. Sulfa drugs will always come second to surgery and third to plasma in saving the wounded, he said. This is because shock and hemorrhage and bomb or shell fragments are the biggest threats to the life of the wounded.

Plasma is given at the clearing stations and sometimes at the collecting stations. At the evacuation hospitals, the surgeons clean the wounds, remove shell or bomb fragments and institute drainage. From 80 per cent. to 85 per cent. of the casualties, he said, are due to shell and bomb fragments, which carry more clothing and infection in the body than rifle bullets. In some places, because of evacuation difficulties, auxiliary groups of surgeons were sent into the forward area to perform operations.

An astoundingly small number of wounded have had the serious bone infection, osteomyelitis, which occurred in 75 per cent. of compound fractures in the last war. In all the base hospitals in Africa, up to April 30, there were only 70 cases of this condition. In one group of 373 compound fractures, there were only five or six cases of osteomyelitis, instead of the 279 which the last war's 75 per cent. rate would have given.

The percentage of survivals in cases of head wounds is much greater than in the last war, as is the survival in cases of abdominal wounds, with even those coming to operation late largely surviving. Of great help for these cases, General Kirk said, is the Levine tube, which goes into the stomach through the nose and by suction keeps the stomach empty and prevents distention. Most fracture cases are transported to the rear in plaster casts, but the casts must be padded. For fractures of long bones, General Kirk is opposed to the method widely used in the Spanish Civil War, of keeping the leg or arm in a plaster cast until the bone sets. Traction is essential in these cases, he said. Only 12 cases of gas gangrene, with one death, occurred, while the Army was still in the South.

The Army has medical installations in every country in the world not held by the Axis, and as soon as it moves into Axis territory, it expects to set up medical units to care for the civilian population. This will be done in order to protect the Army from infectious diseases prevalent among civilians.

The general health of the Army in Africa has been excellent, better than was expected and better even than at home. Venereal diseases are the biggest problem.

"We are going to need more doctors," General Kirk declared. "We must have enough to win this war, and we haven't started fighting yet. Tunisia and Guadalcanal were only side plays."

He added that he appreciated fully the need for leaving enough doctors at home to care for the civilian population. He quoted General Eisenhower as saying that the outstanding service of the whole A.E.F. was that rendered by the medical department.—JANE STAFFORD.

METHODS OF RECOVERY OF SECONDARY OIL

NEARLY two thirds of the nation's oil is left underground by ordinary methods of recovery, representing an estimated seventy billion barrel reserve which challenges the ingenuity of petroleum engineers, according to a report by D. R. Knowlton, director of production for the Petroleum Administration for War, to the New York meeting of the American Institute of Mining and Metallurgical Engineers.

"The most economical and consequently the best source of additional oil for our war program, aside from exploratory drilling, lies in secondary recovery," he maintains. "It is the engineers' problem to get as much of that oil as economically as possible."

At least three billion barrels of the residue left after the easily obtainable oil is pumped can be recovered even by present methods, Mr. Knowlton believes, at present or slightly increased price.

Efforts to find new fields at a cost of millions of dollars per year have met with only moderate success. Unless our record of discoveries is substantially better during the next few years than it has been during the last few, our domestically produced oil will be insufficient to meet our demands, Mr. Knowlton warns.

New knowledge about how to keep up pressure in oil reservoirs as pumping continues and how to control the rate of flow enables engineers to recover much of the so-called secondary oil while still producing the primary oil. Mr. Knowlton urges that new research projects be undertaken to study these methods under varying reservoir conditions.

A NEW SMELTING PROCESS

COAL strikes need mean nothing to the steel industry if a smelting process newly patented by Thomas V. Moore, of Houston, Texas, comes into general use, and the supply of natural gas holds out; for the new method substitutes natural gas and hydrogen (which can be made from some types of natural gas) for the coke on which present-day smelting depends.

Instead of charging a blast furnace with alternating layers of coke, iron ore and limestone, as in present practice, Mr. Moore sifts finely-ground iron ore down through a hopper at the top of a tall tower. Part-way down, the ore particles are met by an upsweeping blast of flaming gas, which heats them to the incandescent state at which they are ready for chemical reaction.

Settling slowly through the turbulent blast, the particles next pass into a zone where hydrogen at a high temperature (above 1300 degrees Centigrade) removes the oxygen from the oxide ore, releasing the iron in molten condition. If the ore is sufficiently impure to require a flux, bits of limestone, fed in through the same hopper, here take up the impurities and form a slag.

Next, the iron particles pass downward through a third zone of hot gases, this time one in which there is an excess of uncombined carbon. The iron takes up some of this, to form the iron-carbon alloy commonly known as pig iron.

Molten iron and liquid slag are drained off through separate openings at the bottom of the furnace, so that the process can be made continuous.

U. S. patent 2,321,310, issued on the method, has been assigned to the Standard Oil Development Company.—FRANK THONE.

ITEMS

A DIVERGENT beam has successfully been used in taking x-ray photographs of crystals. This method promises to be extremely useful in studying the arrangement of atoms in the crystal. As a short exposure is required, it will aid particularly in research with short-lived crystals. This new development in x-ray photography, reported by the British Council, was made at the Royal Institution, London, by Dr. Kathleen Lonsdale with a tube designed by Dr. A. Muller. When the planes of atoms in a single crystal reflect a fine x-ray beam, the reflected beams photograph as sharp black spots on a light background. Substituting a divergent beam for the usual cylindrical pencil, the background becomes darker and the former spots open out into curves. Besides the reflection curves, which are black, the photograph shows "deficiency" curves. These lines are lighter than the general background because radiation in certain directions has been removed from the original beam.

BETTER beer and ale can be expected from recent crosses of European and American species of hops, accomplished for the first time at South-Eastern Agriculture College at Wye, Kent. Reports of success in developing five promising new varieties has been received in Washington from the British Council; the hops were planted in this country and Canada, as well as in England. Acceptance for commercial propagation of the new varieties, which are disease-resistant as well as superior in flavor, represents the culmination of more than a third of a century of patient improvement breeding initiated by Professor E. S. Salmon, and continued under the leadership of Dr. R. G. Hatton, Jesse Amos and F. H. Beard.

DARK green is not always dark in color to the eye of the camera. A new dark green camouflage paint reflects infra-red rays along with ultraviolet rays, and shows up light in aerial infra-red photographs. The new paint is a development of the du Pont laboratories at Wilmington. Infra-red photography is based on the fact that common objects reflect visible light and infra-red rays in a different manner. Most green vegetation reflects infra-red rays. In the infra-red camera used in aircraft, vegetation appears light. An object surrounded by vegetation and camouflaged with ordinary paint the color of the vegetation stands out black against white in the photograph. With the new dark green paint it is concealed.

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THE AMERICAN GEOPHYSICAL UNION

By Dr. J. A. FLEMING

THE American Geophysical Union has to do with those theoretical or applied sciences relating to the earth, its configuration, its structure and the natural forces in operation upon or within it. Since inception in 1919, the Union has gradually developed so that now, with 1,900 members, it is perhaps the principal organization in the United States of America, acting as a clearing house for new thoughts and ideas relating to geophysics.

Sponsored by the National Academy of Sciences through the National Research Council, the executive committee of the union is the committee on geophysics of the council and is the American committee of the International Union of Geodesy and Geophysics. The functions of the union are "to promote the study of problems concerned with the figure and physics of the earth, to initiate and coordinate researches which depend upon international and national cooperation, and to provide for their scientific discussion and publication."

The wide-spread special interests of the eight sections of the union are expressed in the papers presented at the annual meetings, in the regional meetings (often held in cooperation with other scientific organizations) and in the annual "Transactions." Symposia on timely subjects are annual features of the general assemblies.

The fields of the sections of the union are briefly as follows:

(a) *Geodesy:* This section is devoted to large-scale surveying on the earth's surface, dealing particularly with triangulation, leveling and gravimetric surveys. Its objectives are principally determining the shape and size of the earth and adequate mapping of the earth's surface. Borderline subjects are earth-tides and variations of latitude.

(b) *Seismology:* This section is concerned with the solution of problems related to earthquakes and the transmission of vibratory waves through the earth. It deals with the internal constitution and surface structure of the earth which, in turn, find practical use by the geophysical prospector, the foundation engineer, the structural engineer, the geologist, the astronomer and the insurance executive.

(c) *Meteorology:* Meteorology is the scientific study of the physical processes which occur in the atmosphere and of the connected processes of the lithosphere and hydrosphere. It seeks to provide an understanding of the causes of weather and climatic conditions and their changes. These exert a profound influence on the entire course of existence of everything living or inanimate on the earth's surface and in its gaseous envelope. Meteorology is therefore of universal interest, including, as it does, all branches of pure and applied science, technology, agriculture, business, communications and transport, and military and naval strategy and tactics.

(d) *Terrestrial Magnetism and Electricity:* The field of this section is the study of the magnetic and electric phenomena of the earth's interior and atmosphere. Recent developments embrace the vital role of the magnetic and electric properties of the outer atmosphere of cosmic radiation, and of the intimate connection between the electrical and magnetic conditions of the earth and various solar phenomena. The practical utilizations in this field include isomagnetic and isoelectric charts and applications to navigation, wired and wireless communication, determination of subsurface geology and ore-deposits.

(e) *Oceanography:* Covering the greater part of the earth, the sea has a profound effect on man and the world in which he lives. In their interaction with the atmosphere, the oceans exercise a marked influence over climate and vegetation. The configuration of the ocean bottom and the action of tides and currents have an important bearing on maritime activities. Oceanic movements together with the physical and chemical properties of sea water affect marine life and thereby influence fisheries. The sea thus presents a field of research not only for the oceanographer but also for workers in bordering branches of science and in the needs of the world's commerce.

(f) *Volcanology:* The section of volcanology encourages research and the presentation of papers not only in "pure" volcanology but also in many fields such as the study of volcanic and intrusive rocks, relation of ore-deposits to igneous activity and laboratory experiments on processes of volcanism and the formation of igneous rocks and ore-deposits.

(g) *Hydrology:* The section of hydrology deals with the distribution and disposal of precipitation on the land areas of the earth, and as such is a borderline science of interest to agronomists, engineers, foresters, meteorologists, soils technicians, geologists and others, and thus forms a meeting ground for all those who are concerned with any phase of hydrology. Its membership has contributed much in the last decade to theories of precipitation, runoff, infiltration and percolation, movement of flood-waves, soil erosion and the transportation and deposition of sediment, density-currents, the behavior of ground-water, evapo-transpiration, glaciers, the physics of soil moisture and the development of useful techniques for dealing with hydrologic problems.

(h) *Tectonophysics:* The section of tectonophysics coordinates the application of physical methods and geologic and geophysical data to the solution of problems of earth structure, through laboratory experiments, geologic observations and theoretical analyses.

At the twenty-fourth annual meeting in the Hall of Government of George Washington University in Washington, on April 23 and 24, there were 475 registered members and guests. One hundred and four scientific papers and progress-reports were presented.

Nine resolutions were adopted. These relate to (1) precise surveys and maps; (2) essential geophysical observations for duration of the war; (3) implementation of meteorology for war purposes; (4) establishment of more stations in oceanic areas and Antarctica in interest of daily and long-range forecasting; (5) naval time-signal services; (6) adequate post-war program of seismological investigations; (7) practical post-war program in all branches of geophysics; (8) ways and means of providing employment for geophysicists released from war effort during the period of transition from war to peace; and (9) thanks to George Washington University for facilities extended for meeting.

Oscar Edward Meinzer—foremost authority of the United States, and perhaps of the world, on ground-water—was awarded the fifth annual William Bowie Medal for distinguished and outstanding contribution to the advancement of cooperative research in fundamental geophysics. His eminent career is singularly established in these high ideals.

J. A. Fleming was reelected general secretary of the union for 1943–1946; J. A. Duerksen was elected secretary of the section of geodesy for 1943–1946; Ernst Cloos, L. L. Nettleton and M. K. Hubbert were elected president, vice-president and secretary, respectively, of the section of tectonophysics for 1943–1946. No other elections were necessary as the terms of all other officers of the union and its sections do not expire until 1944 or later.

During the years 1919 through 1931 funds required for functioning and publications of the union were provided by the National Research Council. During these years the annual grants of the council for the

maintenance expenses varied from $200 to $1,000 and the total additional amount provided by the council in publishing some 1,250 pages of seven volumes of "Transactions" and one special report entitled "Survey of Research Problems in Geophysics" was about $7,600. With the rapid growth and influence of the union it was arranged that annual dues be contributed by each member from 1932 ($2.00 from 1932 and $3.00 since 1937) and the annual total grant from the council was reduced to an average of $400. From 1932 to date the total of annual dues was $30,337, sales of publications yielded $24,802, contributions for special purposes amounted to $7,597, and grants from the National Research Council aggregated $5,692—a grand total of $69,941. During the same interval the publication of some 26 volumes in 12 years of "Transactions" (7,967 pages in a format equivalent to 12,000 pages of the conventional printer's format), of 5 volumes (400 pages) of "Bibliography of Hydrology, United States of America," and of reprints cost $34,787, the cost of maintenance including a paid clerk from 1937 was $22,210, and the total costs of necessary equipment and special-purpose expenditures was $4,628—a grand total of $61,625. Thus on April 24, 1943, there was a reserve of about $8,316 against future maintenance and publication of the "Transactions" of 1943.

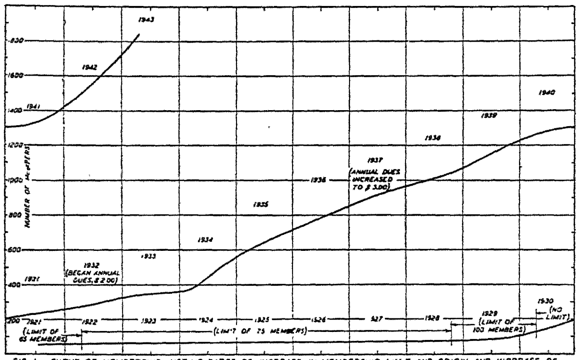

FIG. 1—CURVE OF MEMBERSHIP, NOTING DATES OF INCREASE IN MEMBERSHIP-LIMIT AND ORIGIN AND INCREASE OF ANNUAL DUES, AMERICAN GEOPHYSICAL UNION, 1921–43

This satisfactory performance is the result primarily of the economical methods of offset publication which, with the study of methods of preparing master-copy for direct reproduction, have reduced the total average cost per page for editions of 2,000 to less than one half that of the conventional form of publication in editions of 1,000 only; indeed on a strictly comparable basis of actual content of the page of our "Transactions" and editions of equal number the total cost per page is only one quarter as much. Furthermore, our "Transactions" go free of charge to each member, to a large number of libraries for public reference purposes and to between 300 and 400 of our colleagues in other countries throughout the world.

This brings us to consideration of the union's function in the international aspects of geophysics. We have found means to be represented by delegates at each of the seven triennial assemblies of that body all of which, except the seventh in 1939, were held in European cities. The seventh assembly was held in Washington through the efforts of the American Geophysical Union in cooperation with the Department of State and was judged by our foreign colleagues as one of the most successful of the seven from both points of view of attendance and of scientific discussion. To complete this undertaking the American Geophysical Union found in addition to its own funds some $18,327 to cover expenses of $17,127—over one third was provided by members of the American Geophysical Union and the remainder by generous special grants from the United States Government, the National Research Council, the Geological Society of America and the Carnegie Corporation in almost equal shares of $2,700, after refunds of $300 to each of the three last-named.

It was fortunate indeed that the last assembly, coming as it did almost simultaneously with the outbreak of hostilities, was concluded in the United States. Thus despite the interference since then because of the war with the complete functioning of the International Union of Geodesy and Geophysics, it has been possible, with our colleagues in the United Nations, to preserve a considerable part of the functioning of the international body and thus insure its continuance and its certainty of taking up its important work promptly upon the termination of the war. This has been made possible through the efforts of the officers of the International Union in Great Britain and those in the United States. Of the 33 adhering nations 17 are now Allied or neutral countries and 16 are Axis or Axis-occupied countries. Among American officers are the presidents of the Associations of Seismology and of Terrestrial Magnetism and Electricity, N. H. Heck and J. A. Fleming, and W. D. Lambert is a member of the executive committee of the Association of Geodesy. R. M. Field is chairman of the International Commission on Continental and Oceanic Structure, and J. E. Church is president of the International Commission of Snow. These men have found it possible to carry on and keep alive many of the normal operations concerned. The conditions have not been so favorable in the Associations of Scientific Hydrology and Volcanology since the officers of these associations are in occupied countries; an American, O. E. Meinzer, is chairman of the Commission of Subterranean Waters of the former, and another, T. A. Jaggar, is a vice-president of the latter association. For the Association of Meteorology, the United States is fortunate in having its secretary, Professor J. Bjerknes, in this country so that the interests in meteorology are being followed. For the Association of Oceanography, Dr. J. Proudman, of Liverpool, is secretary so that con-

tinuity of the association's activities is assured. Professor E. Rothé, secretary of the Association of Seismology, died in 1942. President D. la Cour, of the International Union, died on May 19, 1942; under the circumstances, it has not been possible to arrange for the election of a successor, but the general functioning of the union has been maintained through its general secretary, H. St. J. L. Winterbotham.

The general session of the twenty-fourth annual meeting of the American Geophysical Union on the afternoon of April 24 was devoted to a conference on the projected program of the International Commission on Continental and Oceanic Structure. This commission was formed at Edinburgh in 1936 with the instruction to devise, stimulate and sponsor geophysical-geological studies of crustal structure on a world scale, in extension and in support of the similar but less extensive studies made by some of the national organizations adhering to the International Union of Geodesy and Geophysics. Briefly, these may be summarized as follows: (1) Nature and causes of regional magnetic patterns and anomalies; (2) nature, distribution and dynamic causes of regional and gravitational anomalies; (3) nature and causes of regional and temporary variations in radio transmission and reception; (4) nature and dynamic causes of crustal deformation-patterns such as may control regional occurrence or non-occurrence of valuable mineral resources; (5) relation between possible cosmic cycles or rhythms and possible prediction of long-period rhythms as affecting climate and weather; (6) relations of relative climate, hydrology and soils. New authority has been given by General Secretary Winterbotham of the International Union for expenses of the International Commission in the furtherance of its objectives by providing $1,000 proportioned according to the contributions of the several adhering nations. The members of this commission are R. M. Field (*Chairman*); J. A. Fleming (*Secretary*); A. Angenheister, B. Helland-Hansen, O. T. Jones, Harold Jeffreys and F. A. Vening Meinesz. It has been suggested that there be added to the commission Messrs. H. U. Sverdrup, B. Gutenberg and H. H. Hess.

The American Geophysical Union has made free distribution of some 300 to 400 copies of its "Transactions" each year to members abroad of the International Union of Geodesy and Geophysics. Because of restrictions caused by the war, this distribution has been considerably curtailed since 1939, but the union is holding about 200 to 300 copies of each volume for subsequent distribution when opportunity permits.

In the field of snow the avalanche film, which was received from Switzerland through the Swiss Legation last year by President Church, of the International Commission of Snow, has been most valuable, especially in connection with war studies and training concerned with transportation and snow and avalanche conditions.

J. A. Fleming, as a vice-president of the International Union of Geodesy and Geophysics, has continued as the representative of the International Union charged with the deposits of funds of that union in this country. The only expenditures during the year on account of this fund have been $198.70 to the American Geophysical Union to cover the share of the Association of Scientific Hydrology in the expense of the publication of the "Bibliography of Hydrology of the United States of America" for 1940 and $100 to Chairman Field for preliminary expenses of the International Commission on Continental and Oceanic Structure. The payment of the dues of the United States for adherence to the union was authorized for the last year in the amount of $3,920.40 but, because of a blunder, the check for this amount was sent to London and arrangements are now under way for the return of these dues through the American Embassy in London so that the amount may be deposited with other funds of the union with the Riggs National Bank of Washington. The balance on April 24, 1943, in the account at the Riggs National Bank is $6,432.52. With the receipt from England of the last year's dues above referred to, the balance available will be about $10,350—the balance of contribution for adherence of the United States for the calendar years 1939, 1940 and 1941.

The American Geophysical Union has made every endeavor in the past year to increase the coordination and collaboration of interests, especially with the geophysicists of the Western Hemisphere and, as indicated above, to maintain a considerable part of the continuity of the functions of the International Union of Geodesy and Geophysics, thus protecting for the future international relations so essential to geophysical investigations. A recent quotation from a prominent geophysicist of California may be apt in this connection: "The Union, in my opinion, is to be congratulated for having the vision and courage to proceed with the (24th) annual meeting. The Nation needs more, not less, scientific endeavor."

In these days of total war, as never before, responsibility for continued attainment of geophysical knowledge falls with particular directness upon Americans. Now as never before, American scientists personally benefit by affiliation with their fellow specialists and co-workers, since the individual worker is under a great hardship. Now as never before, scientists in general of the Western Hemisphere need to affiliate and play their part not only in the immediate problems of applications to war-effort—to which the geophysicist is contributing effectively—but in the rehabilitation of international relations and endeavors particularly necessary to investigation of earth physics.

ACETYLCHOLINE AND THE PHYSIOLOGY OF THE NERVOUS SYSTEM

By Dr. J. F. FULTON and Dr. D. NACHMANSOHN

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IN a text-book, "Physiology of the Nervous System,"[1] published in 1938, the opinion was expressed that evidence then available to support the theory of "chemical mediation" in the central nervous system was unsatisfactory. Since the problem appeared to be at that time (early in 1938) still open to discussion, only a few short paragraphs were devoted to it. This view was criticized by Forbes[2] and later by Sir Henry Dale[3] both in the columns of SCIENCE. Sir Henry was particularly opposed to the statement that there was "no evidence fit for critical examination that would place the liberation of acetylcholine as a *primary* event, central or peripheral."[4]

Five years have now elapsed. Recent developments have changed many aspects of the problem and its reexamination is desirable. In the text-book[1] it was emphasized that the work of Eccles and Sherrington and that of Lorente de Nó indicates that the excitable properties of the central neuron do not differ fundamentally from those of the peripheral axon, except in the degree of polarization. Hence, it appears unnecessary to assume a mechanism at synapses fundamentally different from that in the axon. At the Symposium on the Synapse in 1939, Gasser and Erlanger[5] reviewing the problem arrived at the same conclusion, *i.e.*, that conduction along fibers and across synapses differ only quantitatively.

Electrical recording instruments have a high degree of perfection. With the oscillograph changes of potential are recorded virtually without inertia. It is difficult to conceive that conclusions based on electrical signs of nerve activity can be contradicted by observations based on methods which are slow, and therefore less appropriate to follow the rapid events accompanying nerve activity. The theory of Dale and his associates that acetylcholine might be the transmitting agent of nerve impulses across synapses and neuromuscular junctions, was based essentially on the type of evidence adduced previously by Otto Loewi in studying the action of autonomic nerves on effector organs: *i.e.*, liberation of acetylcholine by stimulation of motor nerves and preganglionic fibers, establishment of the stimulating action of acetylcholine in small amounts, and the potentiation of the acetylcholine effects by previous eserinisation. Although there remained some contradictions and difficulties, well summarized by Eccles[6] in his review, these were the facts that aroused suspicion and caused criticism. In the case of autonomic nerves the evidence appeared adequate for the assumption that a liberated substance acted as the "mediator"; but transmission of nerve impulses across synapses and neuromuscular junctions are rapid events which occur within milliseconds or even within a fraction of a millisecond. Sir Henry and his associates admitted that this time factor was the chief difficulty encountered by their theory. As long as the time course of the reaction was not established evidence that the liberation of acetylcholine was the *primary* event remained unsatisfactory. The liberated acetylcholine could be a byproduct of nerve metabolism, however essential for the mechanism of nervous action, but *following* the passing of the electrical change. The attempt of MacIntosh[7] to determine the correspondence between the period of preganglionic stimulation and the period during which acetylcholine is present in the perfusate by collecting the venous effluent in 30 second-samples can not be considered as an adequate approach to this essential problem of the time-relation: for 30 seconds constitute an interval some 10,000 times longer than the period during which the impulse passes through those foci.

An entirely different approach to the problem was made by Nachmansohn and his associates. They investigated the problem whether at synapses and neuromuscular junctions the rate of acetylcholine metabolism is as high as required by the assumption that it is a transmitter of nerve impulses. For, if it is the primary event in this transmission, one must postulate that it appears and disappears at least at the same speed as the electrical changes. Little is known about the mechanism of acetylcholine appearance during stimulation; but the ester is inactivated by the specific enzyme, choline esterase, which splits it into its two components. Studies on the concentration and distribution of this enzyme have revealed that at neuromuscular junctions and ganglionic synapses, as well as at all synapses of the central nervous system choline esterase is sufficiently high in concentration to split within milliseconds amounts of acetylcholine which, if released at those foci, would be in sufficient concentra-

[1] Fulton, "Physiology of the Nervous System." Oxford University Press, 1938. Pp. xv + 675.
[2] Forbes, SCIENCE, 90: 17, 1939.
[3] Dale, SCIENCE, 90: 393, 1939.
[4] Fulton, SCIENCE, 90: 110, 1939.
[5] Symposium on the Synapse, *Jour. Neurophysiol.*, 2: 361–474, 1939.
[6] Eccles, *Physiol. Rev.*, 17: 538, 1937.
[7] MacIntosh, *Jour. Physiol.*, 94: 155, 1938.

tion for a stimulating action. And if a substance can be hydrolyzed in a cell at such a high rate it is possible, and even probable, that it can appear at a similar high rate. The work on isotopes has shown that in living cells enzymes are continuously active. A high concentration of a specific enzyme can therefore be accepted as indication of the high rate of the metabolism of its substrate. The results have recently been reviewed by Nachmansohn.[8] They make possible the assumption that acetylcholine intervention is a *primary* event essential in synaptic transmission. The physiological significance of the enzyme mechanism is, moreover, emphasized by the observation that during embryonic development the time when the high enzyme concentration appears coincides with the time when the function of those foci begins.

Further investigations on the activity of choline esterase has led, however, to a modification of the original concept. The new concept is easily compatible with the conclusions of the American and Australian electrophysiologists cited above. According to this concept[9,10] acetylcholine metabolism is intrinsically connected with the electrical changes occurring everywhere at the neuronal surface. Hence, it is only quantitatively more important at the synapse where the neuronal surface increases considerably due to the extensive end-arborisation. The new concept is based essentially on two lines of evidence.

(i) *Localization of choline esterase inside the nerve cell.* In the experiments on the rate of acetylcholine hydrolysis in nervous tissue it was early noticed that the enzyme activity is high everywhere in nervous tissue and the difference between synaptic regions and axon is only a quantitative one. This was particularly obvious in non-myelinated fibers like the sympathetic chain of mammals or the abdominal chain of lobsters.[11] Hence it was concluded that acetylcholine metabolism differs only quantitatively between axon and synapse.[12] This is in agreement with the observation of Lorente de Nó[13] that acetylcholine is liberated in preganglionic fibers as well as at synapses. This observation, contested at one time by the Hampstead school, has meanwhile been confirmed by Lissak.[14] The situation became clearer when experiments on the superior cervical ganglion of cats (after section of preganglionic fibers) indicated that the enzyme might be concentrated at or near the neuronal surface.[15] Further evidence favoring this assumption has emerged from experiments on the giant axon of squids in which it was shown that the enzyme is localized almost wholly in the sheath, the amount in the axoplasm being negligible.[16]

Bio-electrical phenomena occur at surfaces. The localization of the enzyme at the surface and the high rate of acetylcholine metabolism are particularly pertinent in view of experiments in which a close parallelism could be established between the electromotive force of the action potential and the concentration of choline esterase.

(ii) *Electromotive force and concentration of choline esterase.* This parallelism has been brought out in experiments on the electric organs. The discharge of these organs is in principle identical with the action potential of ordinary nerves. The high voltage is obtained by the fact that the electric plates are arranged in series. In the electric organ of *Electrophorus electricus* (Linnaeus), the species with the most powerful electric organ as yet known, there are several thousand electroplaxes arranged in series. The maximal discharge of some specimens rises to more than 800 volts.

High concentrations of choline esterase are found in the strong electric organs of *Electrophorus electricus* and *Torpedo.* These organs hydrolyze in 60 minutes amounts of acetylcholine equivalent to 1–3 times their own weight. Since in the larger specimens the organs have a weight of several kilograms the amount of acetylcholine which can be split in these organs may amount to many kilograms in 60 minutes, *i.e.,* several milligrams in one millisecond. This high rate of metabolism makes possible the assumption that acetylcholine is closely connected with the discharge. The high enzyme concentration is particularly significant in view of the low protein (2–3 per cent.) and high water content (92 per cent.) of these organs.

In the weak electric organ of *Ray* the enzyme concentration is relatively low. If, in the three species, electromotive force per cm and number of plates per cm are compared with the concentration of choline esterase a precise relationship becomes obvious.[17] In the electric organ of *Electrophorus electricus* volts per cm, number of plates per cm, and concentration of choline esterase decrease from the head to the caudal end of the organ in an S-shaped form.[10] If the electrical changes are recorded on the same specimen and at the same section as the chemical values a close parallelism is obtained between voltage and enzyme concentration.[18] This parallelism exists, not

[8] Nachmansohn, *Yale Jour. Biol. and Med.,* 12: 565, 1940.

[9] Nachmansohn and B. Meyerhof, *Jour. Neurophysiol.,* 4: 348, 1941.

[10] Nachmansohn, Coates and Cox, *Jour. Gen. Physiol.,* 25: 75, 1941.

[11] Nachmansohn, *Compt. Rend. Soc. Biol., Paris,* 127: 894, and 128: 516, 1938.

[12] Nachmansohn, *Bull. Soc. chim. biol.,* 21: 761, 1939.

[13] Lorente de Nó, *Am. Jour. Physiol.,* 121: 331, 1938.

[14] Lissak, *Am. Jour. Physiol.,* 127: 263, 1939.

[15] Couteaux and Nachmansohn, *Proc. Soc. Exp. Biol. and Med.,* 43: 177, 1940.

[16] Boell and Nachmansohn, SCIENCE, 92: 513, 1940.

[17] Nachmansohn, SCIENCE, 91: 405, 1940.

[18] Nachmansohn, Cox, Coates and Machado. *Jour. Neurophysiol.,* 5: 499, 1942.

only in regard to the variations which occur in the same specimen, but even in absolute amounts for the variations between the individuals which are quite considerable.

The localization of choline esterase and its correlation with the electromotive force appeared to be specific. Other enzyme systems and substances studied so far—the investigations are still in progress—do not show a similar distribution nor a parallelism with the electromotive force.[18,19] An exception is the localization of vitamin B_1, determined as diphosphothiamin, which is considerably more concentrated in the sheath of the giant axon than in its axoplasm.[19] This again appears significant. Since the breakdown of pyruvic acid, which requires vitamin B_1, is probably important for the formation of acetylcholine, the high concentration of this coenzyme is in agreement with the assumption of a high rate of acetylcholine metabolism at or near the surface. On the other hand, since pyruvic oxidation is of general importance it could not be expected that the vitamin is concentrated at the surface as exclusively as is choline esterase.

The new concept removes the chief difficulty for conciliating the "electrical" and "chemical" theories of transmission of nerve impulses. For it was not the question whether the process is chemical or electrical, but whether there is or is not a special mechanism at the synapses different from that in the axon, which was the basis of the controversy. A satisfactory answer has now been found to this question. There are certainly other factors and reactions involved in the propagation of nerve impulses, but the new investigations indicate that acetylcholine in any case is an essential link in the generation of the electrical changes recorded during activity. Since $V = E - IR$ the ester may act on the surface by producing E.M.F. or decreasing the resistance, or by both. Resistance and electromotive force are closely related properties of the membrane. If an impulse reaches the polarized surface the resistance breaks down. The resting potential disappears or is even reversed. It can easily be envisaged that a polarizing or depolarizing substance which appears and disappears within milliseconds is responsible for these changes.

OBITUARY

MONT ROGERS REID

THE untimely death of Mont Reid on May 11, 1943, is mourned by the community in which he lived and by his many friends throughout the country. Rarely has a man so universally won the love and affection of his fellow citizens. That, during his illness, those in higher walks of life should have awaited daily reports of his progress; that telephone operators, taxicab drivers, hotel clerks and news-stand attendants should have inquired how he fared; that churches should have invoked special prayers for his recovery; that, on his death, the flag on the City Hall of Cincinnati should have been flown at half-mast for one not connected with government; that civic organizations should have attended his funeral services in a body; that the American Surgical Association, meeting at the time in Cincinnati, should have interrupted its scientific program to do him honor—these are but a few of the indications of the extraordinary hold he had established upon his fellows. He was in a true sense the beloved physician.

Mont Reid was born on a farm near the small town of Oriskany, Virginia, on April 7, 1889. His elementary education he obtained largely from his father, who acted as schoolmaster for his six sons and daughter. He attended the Daleville Normal School for two years, then entered Roanoke College, from which he graduated with an A.B. degree in 1908. He entered the Johns Hopkins Medical School in the fall of that year and on graduating in medicine in 1912 was appointed an intern in surgery by Dr. W. S. Halsted, the distinguished chief of the surgical department of the Johns Hopkins Hospital and professor of surgery in the Johns Hopkins Medical School. The following year, 1913 to 1914, he was an assistant resident in pathology, then returned to surgery and held the position of assistant resident surgeon from 1914 to 1918. In 1918 he was appointed resident surgeon of the Johns Hopkins Hospital, a post he occupied for three years. Following this period he was an associate surgeon of the hospital until his departure from Baltimore in 1922. Academically, he was successively instructor in pathology, instructor in surgery and associate in surgery in the Medical School.

In 1922 he accompanied the writer to Cincinnati as his associate in the newly organized department of surgery of the University of Cincinnati Medical College. It was a period of transition with all the difficulties inherent in such a period; and there is little doubt that his loyalty, sound judgment and winning personality contributed greatly to such success as was achieved in the development of the department. He became active and successful in practice and quickly won a host of friends. In 1925 he was appointed visiting professor of surgery to the Peking (later Peiping) Union Medical College of China and spent a

[19] Nachmansohn and Steinbach, *Jour. Neurophysiol.*, 5: 499, 1942.

year there, among his other activities being the organization of a medical unit which saw active service in war. He returned a victim of malaria which, for a time, considerably impaired his health; then assumed his usual work in the department. In 1931 he was appointed professor of surgery and head of the department of surgery in the Medical College and director of the Surgical Service of the Cincinnati General Hospital. These positions he occupied at his death.

Such, in bald outline, is a statement of his career. But it conveys little of his distinction as a surgeon, as a teacher of surgery, as a contributor to the art and science of surgery, as a citizen and as a man. For it can be said of Mont Reid that he won distinction in many fields. His long training under Halsted, whose principles and methods of surgery but few of his pupils better understood or more carefully followed, made him a careful, meticulous surgeon of unusually sound judgment. As a teacher he was not a brilliant lecturer nor an inspiring master of the clinic method of instruction. But at the bedside his kindness to patients, his attention to the salient facts of history, his careful physical examinations, his interpretation of clinical data, his technic in the operating room and his good judgment were an example to his students, both undergraduate and advanced, which stimulated them to do sound medicine. In his association with Halsted, whose assistant he was during his experimental work on vascular surgery, Mont Reid early in his career became interested in the surgery of the vascular system and some of his most important research lies in this field. He was also particularly interested in the surgery of the thyroid gland and contributed importantly to this subject. For the rest he was, like his distinguished teacher, concerned with the fundamental principles of surgery such as the healing of wounds and the control of infection. As a citizen he was not only interested in the development of the Medical College with which he was identified but in the affairs of his city generally; and to the Commercial Club of which he was a member he brought, no doubt, the same good judgment he exhibited in his chosen field. As a man he was tolerant, kindly, patient, and possessed an unusually winning personality which won him a host of friends and the esteem of those in all walks of life. He seems peculiarly to have fitted into his environment, a community of citizens who have an enduring memory for those who serve them well. By them, particularly, Mont Reid will not soon be forgotten.

GEORGE J. HEUER

RECENT DEATHS

DR. HERMON CAREY BUMPUS died on June 21 at the age of eighty-one years. Dr. Bumpus was from 1902 to 1911 director of the American Museum of Natural History in New York, and from 1914 to 1919 president of Tufts College.

DR. ARTHUR DEAN BEVAN, professor of surgery at the Medical School of the University of Chicago, died on June 10 at the age of eighty-two years.

SCIENTIFIC EVENTS

RULES FOR AFFILIATED HOSPITAL UNITS OF THE OFFICE OF CIVILIAN DEFENSE

REGULATIONS were issued on June 8 for Affiliated Hospital Units of the Office of Civilian Defense, of which Dr. George Baehr is the chief medical officer.

One hundred and ninety-one hospitals and medical schools have been invited by the Surgeon General of the U. S. Public Health Service to organize affiliated hospital units of the Emergency Medical Service of the U. S. Office of Civilian Defense. The invitation was extended to so large a number of civilian hospitals because each unit will be called upon for service only in a war emergency affecting its own region. Units will be activated only in event of a grave military disaster affecting the civilian population or military personnel in the area in which the parent hospital is located. Activation of a unit will take place only upon recommendation of the State Chief of Emergency Medical Service and the Office of Civilian Defense Regional Medical Officer, subject to certain limitations imposed by the Surgeon General and the Chief Medical Officer of the Office of Civilian Defense and by agreements with the invited hospitals.

Because these limitations may not as yet be understood by all physicians and hospitals which have been invited to participate in the Emergency Medical Service, the rules governing activation of affiliated units are set down as follows:

(1) Members of the staffs of affiliated units are commissioned in the inactive reserve of the U. S. Public Health Service, generally with the rank of Passed Assistant Surgeon, Surgeon or Senior Surgeon (equivalent, respectively, to Army ranks of Captain, Major or Lieutenant Colonel). They will remain on inactive status for the duration of the war unless urgent need for their services should arise in their region because of an air raid or other grave wartime disaster. When activated under such circumstances, these officers will receive the pay and allowances of officers of equivalent grades in the armed forces.

(2) The two specific purposes for which a unit may be activated are:

(*a*) For duty in an Emergency Base Hospital to which civilian casualties and other hospitalized patients must be transferred because a community is under enemy attack and one or more of its hospitals must be evacuated.

(*b*) For temporary duty to assist the armed forces at the time of an extraordinary military emergency which may temporarily overtax local military hospital facilities. Such temporary assistance will be provided in or near the locality in which an affiliated unit has been organized. The period of emergency assistance is expected to be of short duration and will last only until the Surgeon General of the Army can send in additional medical officers or until he can distribute the excessive load of sick and wounded to military hospitals in other parts of the country. Affiliated units are organized primarily for civilian protection and are not to be used to staff military hospitals as they expand to meet increasing medical requirements of the Army.

(3) Since affiliated units are organized by the Medical Division of the Office of Civilian Defense as part of the Emergency Medical Service of their states, they will be expected to provide aid only in their own or neighboring states. Their members will not be detached for duty in other parts of the country nor, in accordance with the terms of their recruitment, will they be activated for any other duty except those listed in paragraph 2 of this statement.

(4) A unit organized from the staff of a teaching hospital of a medical school will not be called unless the hospital itself must be evacuated or unless there is no unit from a non-teaching hospital to meet the emergency need.

(5) The period of obligation for service will cease at the termination of the present national emergency; the Surgeon General will accept resignations of members of units six months after cessation of hostilities.

(6) A commission in the inactive reserve of the U. S. Public Health Service does not prevent members of an affiliated unit from entering the armed forces; resignation will be accepted for this purpose.

(7) Members of affiliated units may wear the authorized lapel buttons which indicate that they have enlisted for emergency service. They are not to wear the uniform until called to active service and need not purchase a uniform unless the possibility of active service is imminent. Uniforms will not be required for brief periods of active service.

Because it is essential for civilian protection, the organization of affiliated units has received approval of the board of trustees of the American Medical Association. For the same reason, the Directing Board of the Procurement and Assignment Service has authorized "essential" physicians to accept positions in affiliated units.

SEARCH FOR MINERALS IN THE MICHIGAN UPPER PENINSULA

THE Michigan College of Mining and Technology, in cooperation with the Geological Survey division of the Department of Conservation at Lansing, is about to embark on an intensive program of investigation of minerals in the upper peninsula of the state.

Professor A. K. Snelgrove, head of the department of geological engineering, with his colleagues, Professors W. A. Seaman and V. L. Ayres, will prospect geologically the borders of the granite masses of Marquette and Baraga counties, including the Huron Mountain area, for ores of tungsten, molybdenum, beryllium, columbium, etc. Such minerals have already been found there. The task now will be to locate commercial concentrations.

Professor Bart Park, of the department of chemical engineering, aided by the department of mineral dressing, will do analytical work on the samples collected. Dr. R. A. Smith, state geologist, and Franklin G. Pardee, mine appraiser, will consult with the geologists in the field during the summer.

In the Iron River-Crystal Falls area, Iron County, the Federal and State Geological Surveys have already begun a long-term survey of iron resources. This work is being done by Drs. F. C. Park, Jr., and C. E. Dutton, federal geologists, with the collaboration of Mr. Pardee. Aerial photographs are being taken to provide up-to-date base maps. Chemical work on the iron formations, to detect other metals possibly associated with them and hitherto overlooked, will be undertaken.

The University of Michigan is cooperating with the State Geological Survey in exploring for oil and determining methods for more effective conservation. Professors K. K. Landes, chairman of the department of geology, and G. M. Ehlers will carry out stratigraphic and structural studies in the Mackinac Straits region, with particular reference to the correlation of formations exposed there with those containing oil and gas in the fields to the south. The department of chemical engineering will make a general study of the oil and gas fields and operations in the state, especially the Reed City and headquarters fields, to determine possible methods for more effective conservation. Wayne University, through Professor D. C. MacLachlan, will participate in the exploratory projects for oil.

In the copper country, governmental scientific agencies have for some time supplemented the investigations of the mining companies. Since 1942 Dr. J. J. Runner and A. A. Stromquist, of the U. S. Geological Survey, making their headquarters at Michigan College, have been studying the copper mines with a view to finding additional ore.

Stimulus for the field projects came from the Upper Peninsula Mineral Industries Conference which the college sponsored in November, 1942, when representatives of federal and state agencies met at Houghton to receive recommendations from mining companies and to formulate joint plans.

RARE CHEMICALS

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.:

1. Quinoline 2 Carboxylic Acid (Quinaldic Acid)
2. 2,4,5,7-Tetranitrol-1,8-dihydroxyanthraquinone
3. Tetraphenyl arsonium chloride
4. Salicylanilide
5. Salicylchloride
6. 5,15 dihydroxy palmitic acid
7. Tetramethylene Glycol
8. β,β-Dialkylphenylethylamine or its derivatives
9. Lead Tetra-acetate
10. 1-3 Cyclohexadiene
11. 1-4 Cyclohexadiene
12. Purpurogallin
13. β-Cyclocitral
14. Lead Catechol (1 lb.)
15. Myricin
16. o-Hydroxy Phenyl Mercuric Chloride
17. Cholestenone
18. Glyoxylic Acid

EXPEDITION EXHIBITION OF THE NEW YORK ZOOLOGICAL SOCIETY

IN the Zoological Park the New York Zoological Society has opened a two months' exhibition of the methods of initiating and carrying on a scientific expedition to the tropics. It represents the work of the Department of Tropical Research, and was prepared by the director, Dr. William Beebe, and Jocelyn Crane, research zoologist. It is concerned with the forty-third expedition of the department, which spent seven months in the field at Caripito, Venezuela.

Among the exhibits shown are lists of materials, methods of transportation and complete outfits for shooting, photographing and observing; all the steps from the capture of a *Urania* moth to its final publication as a color plate; and from the excavation of Cichlid fish from mud in the dry season to their incorporation in a technical article in *Zoologica;* the flocking of thousands of moths to the gigantic Standard Oil flares in the jungle; various uses of color and pattern in wild jungle life and an exhibit of old volumes dealing wholly or in part with wild creatures in Venezuela and Guiana, such as original Linnaeus, Sir Walter Raleigh, Ulloa, Humboldt, Merian, Stedman and Rohl.

An important section of the exhibit is a series of cases under the heading: "Are You Lost in the Jungle? Whether you are Scientist or Soldier, your Problems are the Same." Then follow three divisions: "Are You Afraid? Are You Hungry? Where is Camp?"

Here, supposing that the soldier or scientist has nothing but his bare hands, actual specimens or photographs and elaborate labels demonstrate his real and imaginary dangers, from *Anopheles,* perai fish, bushmasters and water buffalo, on the one hand, to tarantulas, false coral snakes, vampires and electric eels on the other. Also are shown deadly stagnant and clear jungle water, safe twice-boiled or chemically purified water and potable frog juice.

Under the hunger section is an exhibit of edible creatures from grubs to manatees which can be caught with the bare hands, together with possible foods, such as termites, snails, lizards and snakes, with methods of preparation for eating raw or cooking.

The more simple means for finding one's way when lost are demonstrated, such as use of the sun, Southern Cross, butterfly migration and the circling of a handkerchief on a tall sapling.

W. B.

BOTANICAL SURVEY OF THE ALCAN HIGHWAY

DR. HUGH M. RAUP, of the Arnold Arboretum of Harvard University, and party left Boston on May 30 for a summer's work in the field along the Alcan Highway. The party consists of Dr. and Mrs. Raup and their two children; Dr. Donovan S. Correll, a member of the staff of the Botanical Museum, Harvard University, assistant botanist, and Dr. Charles S. Denny, of Wesleyan University, geologist.

This is Dr. Raup's ninth expedition to northern Canada. The objective is a general botanical survey of the Alcan Highway, which has opened up vast areas that have never been explored botanically. Particular attention will be given to the description of immediately usable botanical resources in the vicinity of Army posts and in areas of potential settlement. The field work is being done with the cooperation of the National Museum of Canada, the Joint Economic Committees, Canada-United States, and the Army Authorities.

Field expenses of the party are covered by grants from the Milton Fund of Harvard University, the General Purpose Fund of the American Academy of Arts and Sciences, the Bache Fund of the National Academy of Sciences, the Penrose Fund of the Geological Society of America and from the general income of the Arnold Arboretum.

E. D. MERRILL

THE OPTICAL SOCIETY OF AMERICA

THE twenty-eighth annual meeting of the Optical Society of America, according to the preliminary announcement, will be held in Pittsburgh, Pa., on October 7, 8 and 9. The program will include symposia on spectroscopy, spectrochemical analysis and astronomy, in addition to the usual contributed papers.

A conference on spectroscopy and its applications

has customarily been held at the Massachusetts Institute of Technology during the month of July. Because of the continuous schedule under which the institution is now operating and the additional courses being offered for Army and Navy personnel, the facilities will not be available for a conference this summer. Arrangements are therefore being made for symposia and contributed papers on spectroscopy and related topics at the annual meeting of the society.

A midwest conference on spectrochemical analysis has been held for several years during the late spring. Tentative arrangements for a meeting this year at Columbus, Ohio, were made many months ago. When the plans of the Optical Society became known to the sponsors of this Columbus meeting, it was decided, in the interest of minimizing travel under war conditions, to cancel the plans for the Columbus meeting and to encourage the authors of papers to present them at the Pittsburgh meeting. The program committee has planned a symposium of papers on "Optics in the Field of Astronomy," the details of which are not yet available. As usual, opportunity will be provided on the program for the reading of contributed papers of general optical interest.

Because of wartime regulations governing the publication of abstracts containing material in the restricted, confidential or secret categories, it is necessary for abstracts to be cleared before the program can be released for publication. The secretary will undertake to obtain clearance of all abstracts received prior to September 1. On the other hand, it is desirable that authors submit abstracts as soon as possible in order that time may be provided for corrections or deletions by the authors if found necessary.

The meeting will be open to non-members as well as members of the society, and those interested are cordially invited to attend. Non-members who desire to receive the advance program or other information in regard to the meeting should address their requests to Arthur C. Hardy, Secretary, Optical Society of America, Massachusetts Institute of Technology, Cambridge 39, Mass.

SCIENTIFIC NOTES AND NEWS

BIRTHDAY honors of the King of England include Knighthood conferred on the Astronomer Royal, Dr. H. Spencer Jones, and on Dr. George Paget Thomson, professor of physics at the Imperial College of Science and Technology. Sir John Fraser, regius professor of clinical surgery at the University of Edinburgh, was made a baronet.

DR. BERNARD ALBERT HOUSSAY, professor of physiology at the University of Buenos Aires, and Dr. Victor Moritz Goldschmidt, professor of mineralogy and geology at the University of Oslo, on May 20 were elected foreign members of the Royal Society, London.

DR. ELLIOTT PROCTOR JOSLIN, professor emeritus of clinical medicine of Harvard University, has received the distinguished service medal and award of the American Medical Association.

A TESTIMONIAL dinner was accorded to Dr. Herbert M. Evans, Morris Hertzstein professor of biology and director of the Institute of Experimental Biology, on June 4, by members of the medical and other faculties of the University of California in celebration of his sixtieth birthday. The celebration was held at the Bohemian Club, San Francisco, under the chairmanship of Dr. William J. Kerr, professor of medicine. On this occasion presentation was made of an anniversary volume published by the University of California Press, "Essays in Biology," containing forty-eight scientific contributions from pupils, associates and friends representing the physiology of reproduction, endocrinology, nutrition and the history of medicine and science. The publication was planned before the present world war and the participants are leading foreign and American workers in their respective fields.

DR. HUGH S. CUMMING, surgeon general, retired, U. S. Public Health Service, is the recipient of new honors. According to the *Harvard Alumni Bulletin*, recently at the Mexican Embassy in Washington, Dr. Victor Fernandez Manero, national director of health of Mexico, conferred on him in behalf of the President of Mexico the decoration, Doctor Eduardo Liceago. At the invitation of the Government of the Dominican Republic, Dr. Cumming lately went to that country to advise the public health authorities of the Republic on matters of health and sanitation. While in Ciudad Trujillo, the President of the Republic, General Rafael Trujillo, conferred upon him the decoration, Orden del Merito, Juan Pablo Duarte. During his visit there Dr. Cumming was made an honorary professor of the University of Santo Domingo, the oldest university on the Western Continent. He was also made an honorary member of the Medical Society of the Dominican Republic.

DR. DAVID RUSSELL LYMAN, of Wallingford, Conn., was presented with the Trudeau Medal for 1943 at the St. Louis meeting on May 5 and 6 of the National Tuberculosis Association.

AT the commencement exercises of Syracuse University, the Arents Medal for distinguished achieve-

ment was awarded to Carl L. Bausch, vice-president in charge of engineering and research of the Bausch and Lomb Optical Company. Arents medals are awarded annually to alumni of Syracuse University through a fund established for this purpose by George Arents, a trustee.

THE University of Chicago on June 12 awarded citations as "distinguished alumni" to fifty-five members of the college classes prior to 1911, including *Astronomer,* Edwin P. Hubble; *Chemist,* Robert R. Williams; *Geographers,* Charles Colby and Stephen S. Visher; *Geologists,* Fred H. Kay and Arthur C. Trowbridge; *Economist,* Harold G. Moulton; *Physicist,* Harvey B. Lemon; *Physiologists,* Arno B. Luckhardt, Franklin C. McLean and Herman A. Spoehr.

DR. WORTLEY F. RUDD, dean of the school of pharmacy and professor of chemistry at the Medical College of Virginia, was honored at a dinner recently by members of the Virginia Section of the American Chemical Society for his part in organizing the section in 1913, the Virginia Academy of Science in 1921 and the Southern Association of Science and Industry in 1941.

IN recognition of his work in the synthesis and manufacture of atabrine, the degree of doctor of science of St. Lawrence University was conferred at commencement on Dr. A. E. Sherndal, plant superintendent of the Winthrop Chemical Company, who was recently elected vice-president of the company.

HARVEY MILTON MERKER, superintendent of manufacturing for Parke, Davis and Company, was awarded by Wayne University the honorary degree of doctor of science in chemistry at the annual commencement exercises on June 17.

DR. WORTH HALE, since 1918 associate professor of pharmacology and assistant dean of the faculty of medicine at Harvard University, will retire from active service on August 31.

DR. A. A. BERG, consulting surgeon at Mount Sinai and Montefiore Hospitals, has been chosen president-elect of the International College of Surgeons to take office as president in 1945.

DR. W. V. CRUESS, head of the fruit products laboratory of the University of California at Berkeley, was elected president of the Institute of Food Technologists at the annual convention of the institute, which met in St. Louis on June 2, 3 and 4.

DR. ARTHUR B. LAMB is retiring as dean of the Graduate School of Arts and Sciences of Harvard University to return to full-time work in the department of chemistry. He is succeeded as dean by Dr. Howard Mumford Jones, professor of English. Dr. Leigh Hoadley, professor of zoology and master of Leverett House, has been appointed to one of two newly established associate deanships of the school.

DR. WM. DEB. MACNIDER, Kenan research professor of pharmacology and head of the department of pharmacology of the School of Medicine of the University of North Carolina, has relinquished the headship to become effective on September 1. He will continue in the department as a research professor.

DR. SAMUEL J. KIEHL, professor of chemistry at Columbia University, will retire on June 30 after serving on the faculty for twenty-six years. He was appointed professor of chemistry in 1938.

DR. C. P. RHOADS, director of Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York City, has been given leave of absence to become chief of the Medical Division of the Chemical Warfare Service of the United States Army, with the rank of colonel. Dr. F. W. Stewart, pathologist, has been appointed acting director, with Dr. Howard Taylor, Jr., as his assistant.

DR. DONALD K. TRESSLER, since 1933 head of the division of chemistry at the New York State Experiment Station, Geneva, has joined the staff of the General Electric Company. He will be concerned chiefly with research on refrigeration and the freezing preservation of foods, working at the laboratories at Bridgeport, Conn.

DR. EDWARD DAWSON DAVY, professor of pharmaceutical chemistry and dean of the School of Pharmacy of Western Reserve University, Cleveland, has been appointed director of the pharmaceutical division of the Winthrop Chemical Company. He will make his headquarters at the plant at Rensselaer, N. Y. Dr. Davy has been associated with Western Reserve University for the past twenty-one years.

DR. STEUART HENDERSON BRITT, who has been director of the Office of Psychological Personnel of the National Research Council, has been commissioned a Lieutenant D-V(S) in the United States Naval Reserve.

BERT E. GROVE, a member of the Raymond Foundation lecture staff of Field Museum of Natural History, has been called to active service with the Army. He will serve with the medical corps. His first assignment is at Camp Custer, Battle Creek, Mich.

LIEUTENANT DONALD T. RIES, formerly park naturalist at Starved Rock State Park, Illinois, and now of the Army Sanitary Corps, has been transferred from Camp Grant, Illinois, and is now at the Station Hospital, Camp Cooke, California, where he is assistant medical inspector.

DR. T. HARPER GOODSPEED, professor of botany and director of the botanical garden of the University of

California at Berkeley, has returned from an expedition to the Andes, after having spent a year and a half in South America, bringing back a collection of dried plants, photographs and picture films. He also represented the Committee on Inter-American Artistic and Intellectual Relations. In this connection he gave two hundred lectures throughout Chile, Peru, Colombia and Argentina and gave numerous showings of three moving picture films in color. At the request of the president of Chile, he selected a site and worked out plans for a national botanical garden and in Peru he reorganized the garden in Lima.

AT a meeting of the Physical Society, London, on June 4, Professor F. C. Bartlett, F.R.S., gave the Thomas Young Oration on "Some Current Problems in Visual Functions and Visual Perception."

THE Anglo-Polish Committee, London, held on May 24 a meeting of commemoration of the four hundredth anniversary of the death of Copernicus at the Royal Institution, London.

To insure a continuous supply of scientifically trained personnel for war industries, a committee of the American Institute of Chemical Engineers, of which Dean Frank C. Whitmore, of the Pennsylvania State College, is chairman, has drawn up a plan, suggesting that all able-bodied men in college, scientific and engineering fields be inducted into the armed forces when they reach the age of eighteen years, but that the thirteen weeks of basic training be omitted and instead that the men be retained in college for further technical training. It is also suggested that the armed services select not over fifty per cent. of such students for active duty, reserving the remaining fifty per cent. to complete their training and enter war industries. At the present time there is no provision for recruiting for war industry. This plan is designed to strengthen the home front as well as the battle front, and to provide the men on the battle front with adequate supplies of essential equipment.

FOR the first time in the history of the Evening Division of the New York University College of Engineering a summer program of degree courses in nearly all departments of engineering will be offered, beginning on July 7. The program was formulated as the result of a survey made in the evening division earlier this year, which indicated that there is a general desire among the students to accelerate their degree training. The majority of the students of the Evening Division are employed during the daytime, many of them with the engineering departments of vital war industries for whom the study of engineering in the evening is an actual adjunct to their positions.

THE Board of Estimate of New York City has agreed to the proposal for post-war construction at Coney Island of a large oceanarium, or aquarium, replacing the abandoned aquarium in Battery Park. Reversing its action of May 6, the board, by a vote of 10 to 5, approved a capital budget amendment providing $42,000 for preparation of plans for the project. The amendment must now be approved by the City Council, where its passage is considered certain, and then the Board of Estimate must give final authorization for the expenditure of the funds. To the $42,000 to be provided by the city, the New York Zoological Society will add $20,000, so that $62,000 will be available for planning the project, which is expected to cost $1,502,000.

DISCUSSION

THE MOBILIZATION OF SCIENCE

THE Kilgore bill (S. 702) amply illustrates the old adage that the road to hell may be paved with good intentions; for while professing beneficent aims toward scientists and technologists, it would in effect turn them over to the power of partisan politics, besides hampering or emasculating the drive of individual effort. According to Dr. Harold G. Moulton, of the Brookings Institution, the government had in its employ in 1939 more than 40,000 scientists, and in wartime a very much larger number.[1] Furthermore, there is no telling how great this number would become if we include all those to be classified as "scientists and technologists" by the false and distorted meanings proposed for these terms in the Kilgore bill, which states (Sec. 2 (b)) (italics mine):

> "Scientific and technical personnel" shall include all persons, excepting physicians and dentists, who *have completed any* course of study in *any* college or university in *any* branch of science or its practical application or who have had not less than an aggregate of six months' training or employment in *any* scientific or technical vocation.

After one semester, college freshmen would become "scientists" whether they passed or not, and any worker in a chemical factory, for example, would become a "technologist" in six months, irrespective of his competence. I must recall here a question posed by Lincoln in his debates with Douglas. Lincoln said: "If you call a dog's tail a leg, how many legs has a dog?" And when many in the audience answered "Five," Lincoln replied: "No, only four. Calling a dog's tail a leg does not make it a leg." This falsification of the meanings of the words "scientist" and

[1] SCIENCE, 96: 524, 1942.

"technologist" would not increase the number of *real* scientists and technologists, but it would classify with them enormous numbers of incompetents and great numbers of members of many labor unions, whose united votes would drown out real scientific opinion. I query if this is an object of the bill.

There seems to be considerable misunderstanding as to the extent to which scientists are "mobilized." *The New York Times* editorial which is printed in SCIENCE for May 28 states: "Despite assertions to the contrary, scientists and technologists are not fully mobilized"; and in the issue of June 4, L. C. Dunn points "to the thousands of biologists of all kinds, of geologists, mathematicians and other scientists whose work has no immediate relation to the war; and to the many laboratories which are operating as usual without reference to either the war or the government." It is true that many scientists are carrying on the control of food and water supplies and the numerous manufacturing operations by which are produced most of the necessities for the civilian population as well as for the armed forces, and also training and teaching more chemists, engineers and other scientists and technologists—but all this is *important* to the conduct of the war, even if it has no *immediate* relation.

Furthermore, the word "mobilized" is a weasel word. Competent scientists and technologists are listed in the membership lists of hundreds of scientific and technical societies and in professional directories, and have also been listed by the National Roster of Scientific and Specialized Personnel. I have yet to hear of cases where scientists have refused to answer a government call; even though many of them probably never will be called, they are all ready to serve, if and when their services are called for. Just as only a few of those "mobilized" in our armed forces are on the actual firing line at any moment, so too many scientists must abide finding their proper and wanted call to the war effort. As Milton wrote: "They also serve, who only stand and wait." And in the meanwhile, they keep the home fires burning. Any attempt to supersede the thousands of actively operating scientific and technological agencies by a dominant group of appointees would be disastrous. And of the seven "top" appointees, only two must be "scientists and technologists" in the falsified meaning of these words.

Human nature and politics being what they are, nepotism and favoritism are not impossible in appointive positions, and government "brass hats" do not always recognize real merit and advanced ideas, as General "Billy" Mitchell and General de Gaulle found out. With the intense competition existing not only in individual businesses but also between whole industries, the urge to develop and perfect new methods and materials and products has led to outstanding advances. Our government scientists do splendid work within their limitations and render great public service; but consider the great array of new products, medicines and machinery (electric iceboxes, autos, vacuum sweepers, vitamins, improved lighting and transportation, etc.) which have been brought to the public at great savings in cost by industrial laboratories. We have Nylon to replace silk and quite a number of "synthetic rubbers"; radios; substitutes for many raw materials cut off by the war; magnesium and aluminum at low cost, etc., etc. According to *Mining and Metallurgy* (April, 1943), under the best conditions only about 5 per cent. of the total development cost of most products is claimed by laboratory research and patent prosecution—the balance goes into pilot-plant research, experimental design and construction and in getting the process into commercial operation. Following Langley's unsuccessful attempt to fly his apparatus, financed by Congress, nothing was done of account until two enthusiastic bicycle mechanics, the Wright Brothers, built and flew their own machine, and established the airplane industry.

Despite the good intentions behind those who framed and support the Kilgore bill, its results will be evil. Neither science nor technology, nor scientists nor technologists will thrive under regimentation. Far from being a "Magna Charta of Science," as Thurman Arnold called it, it might well become a tangle of chains to enslave science and industry. We must guard against unwise concentration of power in the hands of appointees and sub-appointees, and its possible and even probable misuse or abuse, with results that can now be seen in Germany, Japan and Italy.

JEROME ALEXANDER

BIOLOGY AND THE KILGORE BILL

PROFESSOR L. C. DUNN in an article[1] entitled "The Opposition to the Kilgore Bill" takes Dr. Gustav Egloff severely to task for certain of his recent statements concerning the bill, one of which was that "over 95 per cent. of our scientific and technical manpower and facilities are now highly organized and coordinated to the single end of advancing the war effort." Professor Dunn asserts that this statement is certainly not true and goes on to say that "one has only to point to the thousands of biologists of all kinds, of geologists, mathematicians and other scientists whose work has no immediate relation to the war. . . ."

To support his contention, Professor Dunn quotes from an article by Professor J. S. Nicholas, "The War Problem of Manpower in Biology and Agriculture," commenting thereon as follows: [Professor

[1] SCIENCE, 97: 510–11, 1943.

Nicholas] "estimates that in the biological sciences alone exclusive of medicine, there are available about 67,000 scientists."[2]

Professor Dunn appears to have completely misread Professor Nicholas's article, the purpose of which was to show the vital relation of the work of the said estimated 67,000 biological scientists to the war effort. In fact, his whole article is a plea for the conservation of manpower in the biological sciences to prevent an imminent shortage of workers in these fields so essential to the maintenance of our war effort.

A few quotations from Professor Nicholas's article will make this abundantly clear:

> The services must be fed and clothed, and increased amounts of materials essential to these vital functions must be produced by a campaign of blood and sweat as rigorous as that involved in the mining of metals or the extraction of fuel. No other field must contribute so much to the war effort in material and in morale as do biology and agriculture; they provide the ultimate foundation for victory. . . . At no time in our history has this group been loaded with a greater responsibility. This it accepts, asking only that Selective Service carefully consider the importance of the biological group and the maintenance of its personnel; that legislative planners be brought, if possible, to think of how serious and far-reaching would be the effect of ill-considered restrictions of its efforts.

This is a far cry from Professor Dunn's assertions implying that 67,000 biological scientists are available for war work. He evidently disagrees with Napoleon that "An army travels on its stomach" and apparently would have us believe that the only people whose work relates immediately to the war are those who make bullets and those who fire them.

DONALD PRICE

NEW YORK, N. Y.

THE MOSCOW SCHOOL OF TOPOLOGY[1]

FROM a purely logical point of view, topology, the mathematical science of continuity, is one of the most fundamental branches of mathematics. According to Hermann Weyl, all mathematics grows out of algebra, which studies the realm of discrete operations with numbers and other mathematical symbols, and topology unites these symbols into continuous variations.

From a more practical point of view, topology occupies one of the key positions among the many different branches of modern mathematical science. In nearly all these branches of mathematics as well as in many fields of physics and engineering there is an increasing number of problems where the essential difficulty of solution lies in working out a subtle quantitative analysis which can be performed only by topological methods.

Little wonder, then, that topology attracts the special attention of mathematicians the world over. Henri Poincaré, the greatest mathematician of the beginning of this century, devoted his most profound research efforts to topology. In the United States of America topology and its applications occupy almost exclusively such great scientists as Birkhoff, Veblen, Alexander and Lefschetz. The energetic work and brilliant discoveries of the last three mentioned scientists have made Princeton a world center of topological thought which has given refuge to such famous European scientists as Hermann Weyl and J. V. Neumann.

A school of topologists working no less intensively was established in the U.S.S.R. by Paul Uryson, Paul Alexandrov and Leo Pontryagin. Even the initial works of Alexandrov and Uryson, which were done in 1920–1924, created large new branches of topology—the theory of dimensions of Uryson and the theory of bicompact spaces of Alexandrov. Uryson died at the age of 26 and Alexandrov devoted himself with exceptional energy to arranging and publishing Uryson's unfinished work, an activity which resulted in a number of sizable memoirs. Alexandrov at the same time introduced a new trend into topology by devoting his efforts to a synthesis of the classical combinational topology of simplest geometrical figures with general ideas of theoretical-multiple nature. The general combinational topology created by him has become one of the fundamental trends for further research by topologists and mathematicians the world over.

By the end of the twenties Alexandrov's pupil, Leo Pontryagin (now a corresponding member of the Academy of Sciences), collaborated in his teacher's research. After his initial efforts, which constituted a continuation of Alexandrov's work, Pontryagin turned his attention to the theory of continuous groups in which he achieved fundamental results, changing this branch of mathematics at its very roots. His basic accomplishments were published in a book which appeared in 1939 simultaneously in the U.S.S.R. and U.S.A.

In addition to Pontryagin, a brilliant group of pupils has gathered around Alexandrov. Among them are Andrei Tikhonov, Leo Tumarkin and Alexander Kurosh. These men have done a great deal both in topology and in its applications. For instance, Tikhonov (who is now also a corresponding member of the Academy of Sciences) applies topological methods successfully to mathematical analysis and geophysics.

The work of Soviet topologists continues with unabating intensity even in wartime. Alexandrov himself completed during 1941–1942 his fundamental research on the properties of the mutual disposition of

[2] *The Sigma Xi Quarterly*, 30: 4, 294–97, 1942.

[1] Received via radio by the American Association of Scientific Workers.

geometrical figures for which he was granted one of the Stalin first prizes for 1942. Pontryagin, Tikhonov and several other topologists are now actively working on special war problems.

A number of topologists of the younger generation are in the ranks of the Red Army. Some of them send their scientific works to the Academy of Sciences for publication in its Reports, even from the front. Graduate students Shanin and Fomin completed their topological work while in the Red Army and came from the front to take their examinations.

Soviet topologists strive even under the most trying conditions of war not to lose their place in the international cooperation of mathematics.

ANDREI KOLMOGOROV
ACADEMY OF SCIENCES OF THE U.S.S.R.

SCIENTIFIC BOOKS

METEOROLOGY AND CLIMATOLOGY

Basic Principles of Weather Forecasting. By VICTOR P. STARR. 299 pp. 125 figs. New York: Harper and Brothers. 1942.

Workbook in Meteorology. By ATHELSTAN F. SPILHAUS and JAMES E. MILLER. 163 pp. Figs. and maps in end pocket. New York: McGraw-Hill. 1942. $3.00.

Climatology, General and Regional. By THOMAS A. BLAIR. 478 pp. 101 figs. 1 fold map. New York: Prentice-Hall. 1942. $5.00.

An Introduction to the Study of Weather and Climate. By HAROLD B. WARD and WILLIAM E. POWERS. 112 pp. 24 figs. Evanston, Ill.: Privately printed. 1942.

Ways of the Weather. By W. J. HUMPHREYS. 400 pp. 75 figs. Lancaster, Pa.: The Jaques Cattell Press. 1942. $4.00.

THE publication of Espy's epoch-making "Philosophy of Storms" a century ago initiated a period of great development in meteorology in this country. Espy had recruited a corps of volunteer weather observers in the eastern part of the United States, and from the reports received from them by mail he undertook to systematize the information on size, form and rate and direction of travel of individual storms. The later development of the telegraph made it possible to get weather reports quickly and led to the conviction that the weather could be foretold. For a few years prior to the Civil War the Smithsonian Institution issued daily public weather forecasts. Official meteorological services were established in many countries during the 1870's; our own was created in the first year of that decade within the Army Signal Service. Thus meteorology in this country became an official technology and the responsibility for its welfare rested in a government agency, which presently was reorganized and became the Weather Bureau. The chief preoccupation of the bureau was with weather forecasting.

There were no trained meteorologists and unfortunately little encouragement was given to the development of adequate training facilities in the universities. New employees in the Weather Bureau were recruited at the sub-professional level and were trained through a system of apprenticeship to fill professional positions. University administrators were not willing to establish facilities for training and for research in meteorology so long as there were no professional opportunities for graduates.

With the rapid development of commercial and military aviation during the last 20 years there arose a need for weather forecasts more detailed and specialized than the Weather Bureau could provide. In 1927, with the support of the Guggenheim Fund for the Promotion of Aeronautics, an experimental airways weather service was established for the air route between Los Angeles and San Francisco. Carl-Gustaf Rossby was selected to conduct the trial. This airways weather service quickly proved that meteorology could be of inestimable service to aviation and a need for trained meteorologists soon became evident. With the support of the Guggenheim Fund, a meteorology course was instituted at the Massachusetts Institute of Technology in 1928, with Rossby in charge. Gradually, young men who had taken this course began to make themselves felt in the Army and the Navy and in civil aviation. At the same time fundamental research in meteorology was greatly stimulated and graduate work in the subject led to the conferring of the first Sc.D. degree in meteorology in this country about eight years ago. During the last five years Rossby and his students have been responsible for the establishment of departments of meteorology in three other first-rate institutions: New York University (1938), the University of Chicago (1940) and the University of California at Los Angeles (1940).

A logical by-product of the phenomenal growth of aeronautical meteorology in the last decade has been the publication of text-books. Already they occupy a five-foot shelf and they are mostly of very high quality. In the main, however, they are strongly biased by the special needs of aviation and do not even claim to treat of the whole of meteorology. For this state of affairs Rossby and his associates can not be blamed. They realize that there can be no important advance in the art of weather forecasting without

much fundamental work in the science of meteorology. They realize further that there can be no full and sound development of the science so long as any part of it remains neglected.

Nevertheless, there is no opportunity at present for them to do much to round out the development of the science. The present wartime emphasis on military aviation has brought literally thousands of Army and Navy cadets to the existing meteorology departments for training as weather forecasters. The facilities of these schools were so severely overtaxed that both the Army and Navy have found it necessary to establish new schools for training in weather forecasting.

The need for speed in training of weather forecasters for the military services has created many extremely difficult pedagogical problems. The students are not allowed time to acquire an adequate knowledge of the physics of the atmosphere; instead their training in forecasting is reduced, in so far as possible, to a series of empirical rules, and entails as much practice in the laboratory as time will permit.

"Basic Principles of Weather Forecasting" was written for use in the present accelerated training program. Mr. Starr directs the work in experimental weather forecasting in the Institute of Meteorology at the University of Chicago. He has developed special competence in making forecasts from the observations that can be obtained at a single station. Such forecasts are, of course, extremely valuable in many fields of military operation, since there are times when synoptic observations from other stations are unobtainable. The book is almost completely non-mathematical; there are scarcely a dozen equations in it and these are far from formidable. The basic principles are brought together in the first two chapters, the first of which deals with forecasting the field of motion in the atmosphere and the second with forecasting of the actual weather from the field of motion. There are only a few pages on the general atmospheric circulation. Most of the remainder of the book discusses a series of examples of weather forecasts for each of the four seasons. The author makes skilful use of carefully selected synoptic charts and charts of upper-air soundings. The book ends with a brief description of current work on extended-period forecasting. Mr. Starr is a good teacher as well as a skilful forecaster and his book profits from both of these qualities. It should be especially useful in the present emergency.

"Workbook in Meteorology" was also prepared to assist in the rapid training of students in the art of weather forecasting. Its four parts deal successively with climate (mean condition of the atmosphere), instruments and methods of observation, the elements of dynamic meteorology and the weather map. Most of the exercises are carefully prepared and are purposeful; the text is thoughtfully written and the instructions are clear and concise. Unfortunately, there are a few exercises that will be recognized even by the student as busy work. The questions that follow some of the exercises could have been much better. They are mostly of the simple true-false type (the mean position of the heat equator is [north, south] of the geographic equator) and add little to the student's understanding of the work he has been doing. Nor do they help the instructor to estimate the progress of the student. Nevertheless, this workbook should be a most useful laboratory teaching aid and there is little doubt that it will be widely adopted. "Workbook in Weather Forecasting" would be a better title.

There is one part of meteorology that has been neglected more than any other. This part is climatology. A century ago meteorology was mainly climatology, but after the possibilities of weather forecasting came to be realized, the content of meteorology became more and more restricted until to-day it consists almost entirely of "weatherology." In fact, it is no longer realized that climatology is an integral part of meteorology, coordinate with "weatherology" and of equal importance to it. Both subdivisions of meteorology use the same instruments and the same observational data. One is concerned with irregular short-time fluctuations in the state of the atmosphere, whereas the other has to do with the regularly recurrent or periodic changes in the state of the atmosphere from day to night and from winter to summer. The conditions of the atmosphere to be expected at any place over a period of time constitute its climate.

Just as meteorology ("weatherology") is given practical expression in weather forecasting, so climatology finds practical application conspicuously in the fields of agriculture, biology and geography. But climatology has not reached the stage of practical application nearly to the extent that "weatherology" has. Climatology remains largely descriptive; physical climatology is virtually unexplored in this country. Perhaps it will require pressure from the agricultural interests, like that exerted by the aviation interests to secure improved forecasts, before physical climatology will be developed to a point where it can serve practical ends.

Much of the current literature of climatology is written by the geographers. They have a very real interest in climatology because they regard climate as the key to the areal differentiation of the earth. The study of descriptive climatology has, thus, been diligently pursued and studies of the climate of particular places and regions are numerous.

There are a number of text-books on climatology written in the English language. They are largely descriptive and have more or less similar organization, giving information on temperature, rainfall, humidity, pressure and wind for various parts of the earth.

Blair's "Climatology" is such a book. It is no better, and perhaps no worse, than others that have appeared in the past. It will certainly do nothing to advance the science of climatology or to raise the level of teaching of the subject in the United States. The writing is dull and the illustrations are poorly selected and executed. The first quarter of the book deals with what is called general climatology and the remainder with the climates of the world. The book contains some modern material, but it is not adequately assimilated into the text. For example, appended to the discussion of the general circulation, which follows Ferrell quite literally, there is a brief paragraph on air masses. It may be presumed that Rossby's lucid discussion of the general circulation in the 1941 Yearbook of Agriculture (Climate and Man) was available to the author. At least it is listed in the bibliography. Yet there is no indication that he made any use of it.

The failure to deal satisfactorily with the various climatic controls, and particularly the general circulation, makes difficult the discussion of the climates of various regions. For example, when explaining the arid parts of North America he says, in part (page 173), "The southern portion of this dry-climate area, from southern California to Texas and southward into Mexico, is in the subtropical belt of high pressure, which is characteristically dry around the world. In winter, the winds are from north or northwest out of the Great Basin center of high pressure, and they decrease in humidity as they move southward to warmer latitudes. In summer the inflowing winds on the Pacific side pass over the abnormally cool water along the California and Lower California coasts, and hence are dry as they move inland over the very warm land surface." This explanation is repeated in the discussion of the factors influencing the climate of California (page 202).

As a matter of fact, the air that passes over southern California in summer is not dry; it contains three times as much moisture as in winter. Only in the Gulf and South Atlantic states is the summer air moister. Summer rainfall is deficient over southern California because a mechanism for precipitating the abundant atmospheric moisture is lacking. In "Characteristic Weather Phenomena of California" Byers has explained the peculiar rainfall régime of California clearly and simply. It can not be said that the explanation is too complicated for climatology students.

Blair says (page 12) that there are only three methods of transmitting heat: radiation, conduction and convection. The most important process for redistributing heat over the earth's surface, advection, is ignored. So is the most important process for the vertical transport of heat, mechanical turbulence. Convective turbulence is mentioned as the principal cause of high fogs in central California (page 203), but the process is nowhere explained.

"Weather and Climate" is a privately printed book of 112 pages that presumes to cover the whole field of meteorology. It fails completely. There are 10 chapters as follows: earth relations (6 pages), the atmosphere (10 pages), the heating and cooling of the earth (8 pages), atmospheric pressure and winds (6 pages), the moisture of the atmosphere (10 pages), the general circulation of the atmosphere (6 pages), the seasons (2 pages), aperiodic migratory cyclones and anticyclones (19 pages), the weather map and forecasting (9 pages) and climate (22 pages).

This statistical summary of the contents of the book does not tell the whole story of its inadequacy. Of the 6 pages in the chapter on earth relations 5 are irrelevant by any standard in a book on this subject. Three of the 6 pages on atmospheric pressure and winds are wasted on useless illustrations. The chapter on migratory cyclones and anticyclones contains a two-page half-tone reproduction of a daily weather map which is almost completely illegible and of which no use is made in the text. A footnote states, "The map . . . has been cut and made smaller so that some of the explanatory material is omitted." This is not of any importance because the part that remains can not be read. That a world survey of climate can hardly be achieved in a space of 18 pages is obvious. This book is about the equivalent of the corresponding part of a high-school text in general science. One wonders if it is being used in college classes.

The subtitle of "Ways of the Weather" is "A cultural survey of meteorology." It was published in the "Humanizing Science" series of the Jaques Cattell Press. Only Dr. Humphreys could have written this book. He has a rigorous scientific background and at the same time a rare ability to explain things simply and interestingly. His ready wit and his sprightly style are seen here at their best. Little is overlooked in the book; in fact the reader is given a bonus of material not ordinarily found in meteorology texts. Here the author is following the precedent established by his earlier work, "Physics of the Air," but there is an important difference. For example, what he then labeled "meteorological acoustics" he now calls "weather music." Where else can we get a scientific explanation of the murmur of the forest, the roar of the tornado, the howling of the wind, the clatter of hail, the rattle of sleet, the patter of rain, the detonation of meteorites, the swish of the Aurora and the song of the four-horse wagon, in non-scientific language?

Such abstruse subjects as "structure of the atmosphere," "distribution of temperature," "distribution of water vapor" and "distribution and changes of atmospheric pressure" do not readily lend themselves to

interesting presentation for the lay reader, but Dr. Humphreys has made them interesting. Still, "Ways of the Weather" is not for the lay reader alone; it is a book that every professional meteorologist should have, if for no other reason, because it presents the old and familiar substance of meteorology in a new and fresh garb.

C. W. THORNTHWAITE

SOCIETIES AND MEETINGS

THE ILLINOIS STATE ACADEMY OF SCIENCE

THE Illinois State Academy of Science held its thirty-sixth annual meeting on May 7 and 8, at Jacksonville, Illinois, with MacMurray College and Illinois College as hosts. Attendance, although smaller than in recent years, was larger than had been expected, with 329 persons registered.

On the morning of May 7, a general session in Jones Chapel on the Illinois College campus featured two timely addresses. The retiring academy president, F. M. Fryxell, Augustana College, spoke on "American Science in the Development of the Philippines," and Dr. Edson S. Babson, professor of geology, University of Chicago, spoke earnestly of our natural heritage, its benefits and its menace.

During the afternoon of May 7, ten sections of the academy met separately under the direction of section chairmen, in quarters provided by MacMurray College, for the reading of papers by academy members. The Agriculture Section, Dr. O. L. Whalin, University of Illinois, chairman, heard nine papers and had an attendance of nineteen persons. The Anthropology Section, Mr. Ben Nussbaum, Fairbury, chairman, heard ten papers and had an attendance of sixty-five persons. The Botany Section, Dr. K. Richard Johnson, National College of Education, chairman, heard eight papers and had an attendance of twenty-two persons. The Chemistry Section, Dr. H. W. Gould, Northern Illinois State Teachers College, chairman, heard ten papers and had an attendance of twenty. The Geography Section, Dr. L. A. Holmes, State Normal University, chairman, heard four papers by four attendants. The Geology Section, Dr. William E. Powers, Northwestern University, chairman, heard thirteen papers and had thirty-one in attendance. The Zoology Section, Dr. Herbert H. Ross, Illinois National History Survey, chairman, heard seven papers and had an attendance of twenty-six persons.

The Social Science and Psychology and Education sections, with Dr. M. R. Goodson, University of Illinois High School, and Dr. V. Dake Jolley, Wheaton College, as co-chairmen, heard four papers and had an attendance of forty-five persons. These sections also held a special noon luncheon, with Dr. Sylvanus M. Duvall, George Williams College, speaking on the subject, "Wanted, A West Point for Peace Leadership," and a morning session on May 8 to view the University of Iowa's motion picture, "The Effects of Social Climate on Behavior," and to discuss implications of this film for classroom management.

The new Collegiate Section of the Academy, which spans the gap between the Junior Academy of Science and the Senior Academy, with Miss Marjory Merrill, senior in biology, and Miss Eleanor Garvin, senior in chemistry, both of MacMurray College, as chairmen, and Dr. H. R. Wanless, University of Illinois, as coordinator, heard a program of fifteen papers presented by college students from five colleges and universities before an attendance of forty persons.

The Physics Section, Dr. O. L. Railsback, Eastern Illinois State Teachers College, chairman, in recognition of the demands made by war on physicists, asked none of its members to prepare papers but, with twenty-five persons in attendance, devoted its time to a discussion of the preparation and certification of science teachers.

The annual banquet of the academy, held on the evening of May 7, was well attended. The short program included the introduction of new officers and, as the outstanding annual highlight, the awarding by the academy of American Association for the Advancement of Science grants in aid of research to Dr. I. A. Koten, Dr. H. J. Eigenbrodt and Dr. C. L. Bieber, jointly, of North Central College, and to Dr. C. W. Bennett, of Western Illinois State Teachers College.

The banquet was followed by the annual public lecture provided by the academy. Dr. Carl T. Russell, head of the department of research and interpretation of the National Park Service, spoke on the national parks during the war and in the future, illustrating his remarks with lantern slides and with a colored motion picture film.

The morning of May 8 was devoted to tours of inspection of the State School for the Blind, State School for the Deaf and State Hospital for the Insane, all of which are located in Jacksonville. At these institutions the managing officers had arranged special demonstrations of methods and displays of equipment and facilities, by means of which the membership of the Illinois Academy might better understand both what is being done towards the rehabilitation of the blind, the deaf and the insane and also how it is being done.

Officers elected for the coming year were:

President: L. J. Thomas, University of Illinois, Urbana.
First Vice-President: A. E. Emerson, University of Chicago, Chicago.
Second Vice-President: H. W. Gould, Northern Illinois State Teachers College, DeKalb.
Secretary: L. R. Tehon, Illinois Natural History Survey, Urbana.
Treasurer: John Voss, Manual Training High School, Peoria.
Librarian: Gilbert Wright, Illinois State Museum, Springfield.
Editor: Grace Needham Oliver, Illinois State Geological Survey, Urbana.
Junior Academy Representatives: Allen R. Moore, J. Sterling Morton High School, Cicero.
Southern Division: Mrs. Mary Creager, Chester High School, Chester.
Delegate to A. A. A. S.: R. F. Paton, University of Illinois, Urbana. Delegate to Conservation Council: V. O. Graham, 4028 Grace Street, Chicago. Publicity Director: Paul Street, Northern Illinois State Teachers College, DeKalb. General Chairman Local Arrangements for 1944: H. W. Gould, Northern Illinois State Teachers College, DeKalb.

Unless unforeseen difficulties arise, the Illinois State Academy of Science will hold its thirty-seventh annual meeting on May 5 and 6, 1944, at DeKalb, Illinois, with the Northern Illinois State Teachers College acting as host. Dr. H. W. Gould, professor of chemistry at that institution, will act as chairman of the committee on local arrangements and already has his committee for the next year's meeting well organized and at work.

L. R. TEHON,
Secretary

SPECIAL ARTICLES

ISOLATION AND PROPERTIES OF CHICKEN ERYTHROCYTE NUCLEI[1]

LASKOWSKI recently has published an improved method for the isolation of undamaged chicken erythrocyte nuclei.[2]. This method is undoubtedly much superior to the previously existing methods, but a disadvantage of the procedure is that lysolecithin must be used, which is not a convenient substance to prepare and which might not be desirable in case lipid studies were to be made with the isolated nuclei.

We have found that if washed chicken erythrocytes are laked in 0.9 per cent. sodium chloride by means of saponin, the nuclei are rapidly liberated and can be readily isolated by centrifugation followed by washing in 0.9 per cent. sodium chloride solution. The concentration of the sodium chloride solution is very important, since for example if one uses 0.85 per cent. instead of 0.9 per cent. sodium chloride, the nuclei almost invariably form a gel as the result of agglutination while they are being washed.

Our procedure was as follows: Fresh chicken blood was collected at the slaughter house and was defibrinated. The erythrocytes were centrifuged and were washed in 0.9 per cent. sodium chloride solution according to the procedure of Laskowski,[2] except that we have washed only twice. Then they were suspended in sufficient 0.9 per cent. sodium chloride solution to make a volume equal to that of the original volume of blood. To one hundred cc of erythrocyte suspensions was added 5 cc of 0.11 molar phosphate buffer of pH 6.8 to 7.0 containing 0.3 gm of Merck's purified saponin. Practically complete laking occurred in five minutes. The nuclei were then washed four or five times with 0.9 per cent. sodium chloride solution. Usually we have added two or three cc of 0.11 molar phosphate buffer of pH 6.8 to 7.0 to the centrifuged nuclei without stirring, immediately before adding the sodium chloride solution.

Nuclei prepared by this method were found to be of even better microscopic appearance than those prepared by us according to the method of Laskowski. However, we used snake venom to prepare our lysolecithin instead of bee venom as employed by Laskowski. Although upon first examination nuclei prepared using lysolecithin or saponin appeared to be free from stroma, heavily stained preparations examined under high power were found to contain a certain amount of extremely tenuous stroma attached to the nuclei. It appears possible that complete removal of this stroma causes agglutination of the nuclei.

The total lipid content of our nuclei is about 14 per cent., of which a considerable fraction appears to be phospholipid. The desoxyribonucleic acid content of the nuclei, determined by the Dische reaction[3] according to the procedure of Seibert[4] is in the neighborhood of 45 per cent.

The respiration of the nuclei without added substrate was compared with the respiration of nuclei prepared by the method of Laskowski,[2] and also with that of nuclei prepared at pH 6.0 by laking with very dilute citric acid. In the latter preparation much stroma appeared to remain attached to the nuclei,

[1] From the Department of Biochemistry and Pharmacology, University of Rochester School of Medicine and Dentistry, Strong Memorial Hospital, Rochester, New York.

[2] M. Laskowski, *Proc. Soc. Exp. Biol. and Med.*, 49: 354, 1942.

[3] Dische, *Z. Mikrochemie*, 8: 4, 1930.

[4] F. B. Seibert, *Jour. Biol. Chem.*, 133: 593, 1940.

making it impossible to wash out the last traces of hemoglobin. The QO_2 values for these preparations are given in Table 1.

TABLE I

	Nuclei prepared using saponin	Nuclei prepared by Laskowski's method	Nuclei prepared by C citric acid method
QO_2 in 0.9% NaCl buffered to pH 7.4 with phosphate, 37.5° C. .	0.40	0.10 ±*	0.10 ±
QO_2 in 0.11 molar phosphate, pH 6.8, 25° C.	0.26	. . .	. . .

* Laskowski reports an average value of about 0.20 for the QO_2 of his nuclei, with a variation of 0.15 to 0.22. We have made only one determination in duplicate on Laskowski nuclei and our sample may have stood a trifle too long in the ice box before testing.

Nuclei prepared by our method were rather intensely yellow from a pigment which we believe to be largely xanthophyll. To study this pigment the nuclei were washed once with 95 per cent. alcohol, and this washing was discarded. Then the nuclei were extracted three times with 95 per cent. alcohol and the extracts, which contained nearly all the pigment, were combined. The alcohol was evaporated to dryness, leaving a residue of the pigment together with some lipid. This residue was taken up in a small volume of hot alcohol, and on cooling some of the lipid precipitated and was removed. The concentration of alcohol then was lowered to about 92 to 93 per cent. by the addition of water and the pigment was removed from the alcohol by repeated extractions with petroleum ether. These petroleum ether extracts were combined. Subsequent extraction of the petroleum ether with a small volume of 92 per cent. methanol caused the pigment to pass almost quantitatively from the petroleum ether into the methanol layer. The methanol was evaporated to dryness and the pigment, which still contained some lipid, was taken up in carbon disulfide. The carbon disulfide solution gave absorption bands at 444.5, 476.0 and 507.5 mμ, which coincide almost exactly with the positions of bands reported in the literature for xanthophyll.[5] The pigment gave two observable bands in petroleum ether at 444.0 and 475.5 mμ, and in 92 per cent. methanol two bands at 448.0 and 478.0 mμ could be seen. A sample of the pigment that had been evaporated to dryness gave a strong blue color with the Carr-Price reagent.

Although the original alcoholic extract containing the yellow pigment showed practically no fluorescence, a sample of nuclei in which the xanthophyll had gradually disappeared during storage yielded, after drying, a light yellow ether-alcohol extract which was appreciably fluorescent, possibly indicating a flavin pigment.

When the isolated nuclei were suspended in distilled water and the pH was adjusted to about 8.5 with ammonia, a transparent apparently structureless gel was formed which persisted in extreme dilutions. The transparency of this gel is of interest in view of the considerable amount of lipid present. The gel is coagulated to form a rather fibrous precipitate by the addition of a little dilute acetic acid. A similar gel is also formed if 5 or 10 per cent. sodium chloride is added to the centrifuged nuclei, and Laskowski states that saturated sodium chloride solution also causes gel formation. It appears likely that the gel must represent some sort of heavily hydrated lipo-nucleoprotein complex with the lipid in a fairly high degree of dispersion.

SUMMARY

(1) A method has been described for the isolation of chicken erythrocyte nuclei using saponin to lake the cells. Nuclei prepared by this method have been compared with nuclei prepared by the method of Laskowski[2] and with nuclei prepared by a citric acid method, particularly in regard to respiration.

(2) The total lipid content of the nuclei is about 14 per cent. and the desoxyribonucleic acid content is about 45 per cent.

(3) A yellow pigment contained in the nuclei appears to be xanthophyll.

(4) A gel formed by the nuclei at pH 8.5 in the presence of ammonia and the absence of other cations is described.

This work was supported by the International Cancer Research Foundation, of Philadelphia, Pa.

ALEXANDER L. DOUNCE
TIEN HO LAN

FRACTIONAL CEPHALIN-CHOLESTEROL FLOCCULATION IN HEPATIC DISEASE[1]

SINCE 1938, when Hanger[2] first described the ability of sera from patients with intrahepatic disease to flocculate an emulsion of cephalin and cholesterol, a number of reports have appeared in the literature (summarized in a recent contribution from this institution[3]) indicating the validity of this laboratory procedure as an aid in the study of disorders of the liver. This test has proved to be of particular value in the differentiation between hepatogenous jaundice and

[5] H. Gilman, "Organic Chemistry, An Advanced Treatise," Vol. II, page 1149. New York: John Wiley and Sons, 1938.

[1] From the Medical Research Laboratory and the Division of Pathological Chemistry, New York Post-Graduate Medical School and Hospital, Columbia University, New York.

[2] F. M. Hanger, *Trans. Asn. Am. Physician* 53: 148, 1938; *Jour. Clin. Invest.*, 18: 261, 1939.

[3] C. H. Greene and M. Bruger, *N. Y. State* 43: 318, 1943.

early obstructive jaundice (*i.e.*, before damage to the hepatic cells has occurred).

The cephalin-cholesterol flocculation test as originally described, however, fails to provide adequate margin for the study of alterations in the degree of damage to the hepatic cells. The purpose of this preliminary report is to show that the degree of cephalin-cholesterol flocculation produced by the addition of various concentrations of serum, when carried out at intervals, may be used as an index of increasing or decreasing hepato-cellular pathology.

The cephalin-cholesterol emulsion[4] was prepared according to the procedure originally described by Hanger.[2] Five chemically clean test-tubes (10 ml capacity) were set up each containing 4 ml of 0.9 per cent. NaCl and 1 ml of the diluted lipid emulsion. To Tube I was added 0.1 ml of the patient's serum and the contents mixed. Decreasing concentrations of serum were then prepared according to the following schedule:

Dilution 1.—0.1 ml of serum diluted with 0.9 ml of 0.9% NaCl.

Dilution 2.—0.1 ml of Dilution 1 diluted with 0.9 ml of 0.9% NaCl.

Dilution 3.—0.1 ml of Dilution 2 diluted with 0.9 ml of 0.9% NaCl.

Dilution 4.—0.1 ml of Dilution 3 diluted with 0.9 ml of 0.9% NaCl.

To Tubes II, III, IV and V were added 0.1 ml of Dilutions 1, 2, 3 and 4, respectively. The tubes were placed in a rack and kept at room temperature for 24 hours. The degree of flocculation of the cephalin-cholesterol emulsion was then read and graded from 0 to ++++, the former indicating no flocculation and the latter complete clearing of the supernatant fluid.

The table shows the results obtained in two of seven patients with simple (catarrhal) jaundice. In Case I. F., fractional cephalin-cholesterol flocculation tests carried out at intervals indicated increasing hepatic damage from the day of admission to the hospital until the 34th day when the icterus index reached 188 units. Clinical improvement was evident on the 48th hospital day when flocculation failed to occur in Tubes IV and V. In this patient, the extent of fractional flocculation appeared to vary directly with the icterus index. In Case D. C., clinical improvement was accompanied by decreased to absent flocculation in the high dilutions; of interest was the lag observed in the diminishing cephalin-cholesterol flocculation compared to the decided decrease in the icterus index on the 28th hospital day. This is not unlike the lag in the return of the erythrocyte sedimentation rate to normal commonly encountered in patients recovering from acute rheumatic fever.

[4] In these studies, the cephalin-cholesterol antigen prepared by the Difco Laboratories, Detroit, Michigan, was used.

TABLE I

FRACTIONAL CEPHALIN-CHOLESTEROL FLOCCULATION IN TWO PATIENTS WITH SIMPLE (CATARRHAL) JAUNDICE

Days	Cephalin-Cholesterol Flocculation Tube I (0.1 ml serum)	Tube II (0.01 ml serum)	Tube III (0.001 ml serum)	Tube IV (0.0001 ml serum)	Tube V (0.00001 ml serum)	Icterus Index
	Case I. F. Female, age 45 years					
0	++++	++++	+++	0	0	94
11	++++	++++	+++	0	0	125
17	++++	++++	+++	++	0	150
34	++++	++++	+++	+	+	188
42	+++	+++	++	+	+	150
48	+++	+++	+	0	0	107
	Case D. C. Female, age 46 years					
0	++++	+++	+++	++	0	125
28	++++	+++	+++	+	0	21
49	+++	+++	++	0	0	13

Summary: The fractional cephalin-cholesterol flocculation test appears to be a valid procedure for following alterations in the degree of hepato-cellular damage in patients with diseases of the liver. When carried out at intervals, the fractional test permits the evaluation of injury to the hepatic cells in terms of increasing or decreasing pathology.

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STUDIES ON PERIPHERAL VISUAL ACUITY

ALTHOUGH peripheral visual acuity curves are well known, there has been very little work done to determine normal variability or to correlate this acuity with other visual functions. Certain wartime accidents under combat conditions have indicated that faulty peripheral acuity, unknown to the individual, may have been responsible. This prompted the writer to develop a reasonably short, accurate test of this visual function and to investigate the possibility of improving it by systematic training. A brief report is presented herewith.

Peripheral visual acuity (or efficiency) was measured by the use of Landolt broken circles with breaks of the following sizes; .5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9 and 10 mm, fitted to a carrier mounted on a 25 cm perimeter. Illumination was kept constant with a built-on illuminator, the light from a 60-watt Mazda daylight lamp 35 cm from the test object being incident at 45°. Surrounds and operator were blacked out. Nine points on each eye, 30°, 60° and 90° from the line of vision, were tested with the other eye blacked out. The test object was covered with a black paddle and then revealed successively in any of four possible positions corresponding to points of the compass (N, S, E or W), the subject signaling the position with the eye fixed forward. Four consecutive successful identifications were necessary for a score. The

size of the break in the smallest circle successfully identified was scored, the sum of 14 points being the total score. The 90° points were generally too weak to have scoring value. The reciprocal of the total score was used for percentage determinations. One hundred subjects selected at random were tested to determine the norm. The average of all scores was arbitrarily chosen as 100 per cent. On this basis 87 males scored 102 per cent. and 13 females 91 per cent. The best subject scored 364 per cent. and the worst 43 per cent. The peripheral acuity thus measured was found to be an independent factor: it did not correlate accurately with age, sex, central acuity or color vision. There was a positive correlation with central acuity of .39, yielding no practical reciprocal predictive value. Although the youngest group was the best, the peripheral acuity did not decline steadily with age. The oldest of four groups (40–70 years) was the second best age group. Eight color-blind individuals scored an average of 92 per cent. The test showed a .91 reliability.

Of the original group of one hundred, 30 were males from 18 to 27 years of age inclusive, who had normal or better central vision, normal color vision and no astigmatism; the requirements for aviation cadets. Their average score was 115 per cent., the best scoring 210 per cent. and the worst 52 per cent. These latter two represented the 2nd and 99th in degree of peripheral acuity of the original group of 100.

A shortened version of the test taking from 12 to 14 minutes (as compared to from 40 to 60 minutes for the original) was run on another group of 113 subjects and was repeated in from 8 to 10 weeks. The second scores showed an average of 6 per cent. improvement. Twenty of the original group of 100 were retested and showed an average of 16 per cent. improvement. The improvement was roughly proportional to the amount of time taken by the test. In two test groups out of three the second eye tested better than the first.

This investigation has revealed great spontaneous variability in peripheral visual acuity, incidentally always without the individual's awareness. It shows such acuity to be an independent visual factor. The evidence indicates that peripheral visual acuity can be trained. Experiments in testing, training and correlation are being continued.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MACROCHEMICAL REACTION FOR THE DETECTION OF PEACH MOSAIC[1]

SINCE the beginning of the program for the eradication of peach mosaic in western Colorado, difficulties have been encountered in the detection of symptoms of the disease in certain horticultural varieties of peach which did not show constant symptom manifestations.[2, 3] Because of these difficulties, the possibility of using a differential color reaction as a supplementary aid in the detection of the malady was investigated. Hutchins[4] in 1933 was the first to use a chemical color reaction as an aid in the identification of a virus disease of peach, the phony disease. Rawlins and Thomas[5] described a microchemical reaction for another virus disease present in peach, the buckskin disease of cherry and other stone fruits.

The Elberta peach variety was used for the test herein described because it showed symptom manifestations of the strains of the peach mosaic virus[6] throughout the entire growing season. The Elberta trees used were grown upon "natural" peach seedling rootstocks. The thinnest possible complete free-hand sections about ¼ inch in diameter were cut from healthy and diseased roots and stems. Sections were placed in a watch glass and a drop of a saturated solution of phloroglucinol in 100 per cent. methyl alcohol was added to each section. After this solution evaporated to dryness, a drop of a solution of nitrophenolic acid in methyl alcohol was placed on each section and allowed to evaporate to dryness. This solution was prepared as follows: Fifty ml of concentrated nitric acid were added to ½ gram of C.P. phenol and allowed to stand over night. An equal volume of water was added the following day and the solution allowed to stand for about 18 hours. Three drops of this solution were placed in 25 ml of 100 per cent. methyl alcohol.

Differentiating color reactions were found to be characteristic of the xylem of sections from healthy trees and from trees infected with the severe and medium strains of the peach mosaic virus. Healthy stem and root portions turned a color varying between Persian lilac and Daphne pink,[7] while virus-infected seedling rootstocks and stems of Elberta

[1] Scientific Series Paper No. 155.

[2] E. W. Bodine and L. W. Durrell, *Phytopath.*, 31: 322–333, 1941.

[3] L. M. Hutchins, E. W. Bodine and H. H. Thornberry, *U. S. Dept. Agr. Circ.* No. 427, 1937.

[4] L. M. Hutchins, *Ga. State Ent. Bull.*, 78, 1933.

[5] T. E. Rawlins and H. Earl Thomas, *Phytopath.*, 31: 916–925, 1941.

[6] E. W. Bodine and L. W. Durrell, *Phytopath.*, 31: 4, 1941.

[7] R. Ridgway, "Color Standards and Nomenclature." 43 pp. 53 colored plates. Washington, 1912.

ranged in color from maize yellow to apricot yellow. Color reactions showed greatest contrast when materials were collected in the fall and early spring and tested immediately. They were not distinctive when tests were made during the active growing season. Sections from peach trees affected with other virus diseases, namely the Golden net and the "X" disease, showed no differential coloring.

Further studies are in progress to determine the effectiveness of the reaction in the detection of the disease in seedling rootstocks onto which other peach varieties are commonly budded.

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A METHOD FOR NARCOTIZING HOLOTHURIANS

AT the Marine Biological Laboratory, Woods Hole, various methods have been tried for narcotizing *Thyone briareus*. These sea cucumbers are widely used in invertebrate zoology courses throughout the country, either as live material when available along the Atlantic coast or as preserved specimens further inland. It is highly desirable to find a method of expanding these animals without the waste of a high percentage of the specimens in the treatment.

The Supply Department at Woods Hole has, for many years, obtained expanded specimens of holothurians by treating them in the field. The undisturbed animal with extended tentacles is quickly grasped back of the tentacles before it has time to retract. The oral end is then immediately dipped into a solution of nitric acid and paralyzed. The specimen is then placed directly into a formalin solution. This method is cumbersome and requires much time, especially since *Thyone* is not nearly as common as it once was in the area. It is not at all practical to use this method on the sea cucumbers brought into the laboratory, since only a small per cent. of the animals will normally extend the tentacles in the aquarium.

Dr. T. H. Bissonnette, Trinity College, advised me that a saturated solution of chloretone in sea water had been used during the past few summers in preparing *Thyone* for class use. Fifteen cc of the solution were injected into the coelom of each animal. He also stated that the method was unsatisfactory; many of the specimens did not relax.

During the summer of 1942 while instructing in the invertebrate course at Woods Hole I tried several methods of anesthetizing *Thyone* without success. Several attempts were made, using the saturated chloretone solution for injection and immersion. The animals remained turgid several hours after this treatment. A saturated solution of magnesium sulphate was tried since I had earlier achieved some success in narcotizing the California sea cucumber, *Stichopus*, with this chemical. *Thyone* did not relax when submerged in the solution nor when injected with it.

Ledingham and Wells[1] have successfully narcotized marine annelids with magnesium chloride solution. They used 80 grams of crystalline magnesium chloride dissolved in 1,000 cc of tap water, and immersed the annelids in the solution for a period of 1 to 4 hours for relaxation. I tried the same solution on *Thyone*. The animals remained turgid after being immersed for 12 hours.

The same solution was used as an injection into the coelomic cavity and was successful in 100 per cent. of the trials. Each specimen was injected with approximately 15 cc of the solution and then submerged in a vessel containing the same solution. A relatively fine hypodermic needle should be used since a part of the intestine often escapes through a hole in the body wall made with a coarse needle. The injected animal becomes very turgid for about 15 minutes and then gradually relaxes. After one hour some of the specimens will extend the tentacles without manipulation. In the others the tentacles may be worked out easily by suspending the animal from the aboral end and applying pressure to the bulb of fluid thus formed. Over 100 *Thyone* were relaxed in this manner. About half of them were animals which were regenerating after having evicerated about a month previous to the date of relaxation.

Three of the narcotized sea cucumbers were placed in running sea water and had regained their turgidity after about 48 hours. Time was not available for a longer observation.

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[1] Isabel C. Ledingham and G. P. Wells, *Nature*, 150: 121, 1942.

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SCIENCE NEWS

Science Service, Washington, D. C.

PROTEIN AS A BY-PRODUCT OF ALCOHOL DISTILLATION

"MEAT" sandwiches without visible meat but rich in body-building proteins may result from a new process developed by chemists of the U. S. Department of Agriculture. A billion pounds of protein could thus be recovered annually by alcohol distillation from wheat. Equipment has already been designed for commercial production based on the process developed by Irwin W. Tucker, working under Dr. A. K. Balls, chief of the enzyme research laboratory of the department. Wheat is treated with sodium sulphite solution, a plentiful waste product of paper mills and other industries. The extracted protein clots and rises to the surface as a thick, yellow froth. When dried it looks much like dried egg white.

The protein is suitable for human consumption, especially when granular flour is used in the process. Its cost would be only about five cents a pound. Some look for the protein enrichment of bread, which would help make up for meat supplies that have been nearly cut in half. Cereal products could be similarly treated. Essential chemical products, such as casein, are also possibilities.

Meanwhile, distillers expect to use the solution that is left after the protein separation to replace barley malt, now the most expensive single ingredient of the alcohol distillation process. This, together with the protein by-product, will save the government $50,000,000 on the 500,000,000 gallons of war alcohol being bought from distillers annually.

After the war we may look forward to large-scale production of grain alcohol for synthetic rubber and other industrial products. Fully developed, the new process will cut former prohibitive costs of peacetime grain alcohol production by at least half. Some say it will pay for the production of the alcohol and then debate as to whether the protein or the alcohol is the by-product.

Production problems will also be solved by the Balls-Tucker discovery. Sticky gluten, extracted by the new process, has been gumming up distillation equipment, thereby forcing frequent shutdowns. In addition, the process reduces the distillation residue to a thin liquid which is much easier to dispose of than former wastes. Protein has heretofore been recovered at the end rather than at the beginning of distillation, and the product was good for little but livestock feed. The new, simpler process gives higher yields and the product is pure enough to be used in human food.

VOCATIONAL COURSES IN ENGINEERING

MORE than a million young men and women have received special training in engineering, scientific and technical subjects, to fit them for specific tasks in the armed services and in the nation's industrial war effort, according to the report of Dean A. A. Potter, of the Purdue University engineering department, speaking before the Lafayette, Ind., meeting of the American Society of Agricultural Engineers. This does not mean, however, that we have added a million engineers to our professional ranks. The courses given are to a large extent below college level, are designed specifically for particular ends, and do not lead to degrees.

"It is to be hoped," Dean Potter said, "that the experience which our engineering colleges have gained through the war training programs will be capitalized by them during the post-war period, not only in improving their regular programs of study leading to degrees, but also in establishing a large number of technical institutes all over the country with intensive practical programs closely linked to the needs of the industries in the communities."

There is an extreme need, he continued, for fully trained engineers, which is not being met by the present regular programs of the engineering schools. The National Roster of Scientific and Specialized Personnel estimates that 40,000 to 50,000 additional engineers will be needed during 1943 and that the potential college production during the current academic year is only 17,000.

Intensive efforts are being made to close the gap, which the speaker described. Thousands of young men in V–1 and V–7 classifications are being given special courses in a number of colleges, under Army and Navy auspices, and they will be given V–12 classification and assigned to continue their studies on completion of the preliminary courses. By streamlining the professional curricula, and by cutting vacations to a minimum, it is expected that a new supply of well-trained engineers can be brought out in much less than the conventionally required time.

One hitch looms: unless the present Selective Service regulation on deferment is changed to extend the period beyond July 1, 1945, "a serious gap in the continuity of supply of engineers will develop very shortly. In general, the needs of our war industries will not be fully satisfied unless an 'industry reserve' or some other scheme is set up . . . for the purpose of insuring an adequate supply of engineers."

BISMUTH AND RECOVERY FROM MALARIA

GIVING a bismuth compound with quinine may speed recovery in some cases of malaria, is suggested by Dr. Martin D. Young, Dr. Sol B. McLendon and Dr. Roy G. Smarr, of Columbia, S. C., in a report to the *Journal* of the American Medical Association. This report is based on paresis patients who were given malaria to cure their syphilitic condition, but it is stated that the combination of thiobismol and quinine "might be useful in malaria infections generally."

The bismuth compound seems to injure the half-grown vivax malaria parasites and reduce their numbers in the blood. As a result the drug eliminates the fever paroxysms which that brood of parasites would have produced. For patients of syphilis of the brain and nervous system, this means that the malaria given to cure their

syphilitic condition can be controlled to produce fever paroxysms every other day instead of every day. The daily paroxysms often tax the patient so severely that he can not continue the full course of treatment.

For curing the malaria, once its effect on the syphilis has been achieved, quinine is usually given. Quinine, however, frequently does not prevent the occurrence of the fever paroxysms for several days after it has been started. When the bismuth compound is given at the same time as the quinine, it prevents the paroxysm of the next day and after that the quinine controls the infection.

The bismuth compound used was sodium bismuth thioglycollate, known also as thiobismol. The studies were made at the South Carolina State Hospital, to which Dr. McLendon and Dr. Smarr are attached. Dr. Young is stationed at the malaria research laboratory at Columbia of the U. S. Public Health Service, National Institute of Health.

THE JAPANESE EARTHQUAKE

SEISMOLOGISTS of the U. S. Coast and Geodetic Survey reported after study of telegraphic and radio data transmitted through Science Service from a number of American and overseas observatories that the earthquake on Sunday, June 13, off the coast of Japan, was twins, with one shock at 1: 11.7 A.M. and the other at 4: 36.5 A.M., EWT. Both quakes started from beneath the same epicenter, which was in latitude 37.5 degrees north, longitude 142.5 degrees east.

This spot is in the Japan Deep, a "hole in the bottom of the sea" off the northeast coast of Honshu, the main Japanese island. It is possible that a tidal wave was caused. Such a wave was started by an earthquake under the same deep, but a few score miles northward of Sunday's epicenter, on March 2, 1933; it sent a 96-foot wave charging up narrow Ryori bay, and drowned out a number of fishing villages all along that coast. However, even if a big wave was started by the present double earthquake, it is not likely that material damage would be caused in the Tokyo-Yokohama industrial area, which is well to the south.

Another pair of earthquakes was reported from the China sea a few days before. Both occurred on Tuesday, June 8, but data from the remoter observatories were delayed in transmission. The first shock which started at 4: 42.2 P.M., EWT, centered in latitude 19 degrees north, longitude 116 degrees east. This is in the north central China sea, about midway between Luzon and the Chinese island of Hainan. The second occurred at 11: 06.7 P.M., EWT, and had its epicenter in latitude 9 degrees north, longitude 120 degrees east, in the northern part of the Sulu sea, in the southern Philippines. Both were strong shocks.

Stations reporting were the government observatories of Sydney, Australia, and Wellington, New Zealand; the Franklin Institute, Philadelphia; the Des Moines, Iowa, Observatory; the observatories of the Jesuit Seismological Association at St. Louis University and Weston College, Mass., and the stations of the U. S. Coast and Geodetic Survey at Sitka and College, Alaska; Tucson, Ariz.; Chicago, Ill., and Honolulu, H. T.

ITEMS

A NEW research laboratory, built at Akron, Ohio, at a cost of $1,325,000 by the Goodyear Tire and Rubber Company, is now ready for operation. It was dedicated at a two-day symposium on June 22 and 23, in which outstanding research workers representing many leading industrial and scientific laboratories participated. The laboratory building contains 74,000 square feet of floor space, and will house the activities of a large part of the Goodyear research staff, which at present comprises 125 chemists, physicists, engineers and metallurgists, along with some 400 others who spend full time on field work. Included in the equipment are such powerful research tools as an electron microscope, an analytical spectrograph and an infra-red spectrometer. All research work at present is of course devoted to winning the war. When victory comes, it will return to normal peacetime pursuits.

POTATO growers in parts of the country where length of season permits two crops a year to be produced are having difficulty in obtaining enough seed potatoes to put in the second crop. For their benefit, Dr. R. A. Jehle, state plant pathologist at the University of Maryland, suggests possible use of seed pieces from this year's early crop, chemically treated to induce them to sprout without waiting through the rest period usually required by seed potatoes. The treatment, first developed at the Boyce Thompson Institute for Plant Research in Yonkers, N. Y., consists in soaking the cut seed pieces for an hour in a solution of sodium thiocyanate, one pound of the chemical to 12 gallons of water. It is essential that the seed potatoes have a cut surface; whole ones will not respond.

CORN yields in bad years, when the weather is either too wet or too dry, can be materially increased by putting commercial fertilizer in the bottom of the furrow as the field is plowed, instead of spreading it broadcast as is now the practice. This discovery was made by agricultural engineers at the Indiana State College of Agriculture at Lafayette; it is reported in detail in the new issue of *Agricultural Engineering*. The problem, it is explained, was to get into place for most efficient use the second, or "sustaining" application of fertilizer. The "starting" fertilizer is already placed in strips at the right distance from the seed as planted. A mechanical attachment for use with plows has been developed, which drops the fertilizer at properly spaced intervals in every second furrow.

TEST periods for heavy-duty diesel lubricants have been cut from nearly three weeks to only a day by development of a new test engine. Success of a single-cylinder Fairbanks-Morse engine as a research tool was reported to the meeting of the Society of Automotive Engineers by H. L. Moir, W. J. Backoff and N. D. Williams, of the Pure Oil Company. Their tests revealed that ring-sticking or sluggish ring action caused more power loss than increased piston temperatures. Variations in ring-sticking time for each type of lubricant are reported due to differences in refining and sources of crude. Although some oils cause less ring-sticking, they may produce dirty pistons, so cleanliness also had to be considered in evaluating and producing heavy-duty type lubricants.

Today this flag flies over

From this world headquarters for radio-electronic research flow new weapons, new discoveries and inventions vital to the winning of an Allied victory!

TODAY, over RCA Laboratories, flies a new distinguished battleflag—the coveted Army-Navy "E" Award.

One of the few laboratories in America to receive this award, RCA is at once proud of this distinction, and humbly aware of the responsibilities that it imposes. For much of the progress of the entire radio-electronic industry stems from the work done in these laboratories.

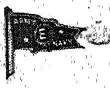
It was perhaps with this thought in mind that—at the dedication of the RCA Laboratories in Princeton—the Chief Signal Officer of the Army called them "The Hidden Battlefront of Research."

HIDDEN—because, for the duration of the war, this magnificent building of 150 separate laboratories must be closed to all but the scientists and research technicians who are working on radio-electronic instruments important to our military effort.

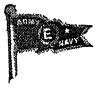
BATTLEFRONT—because in the waging of modern warfare, radio-electronics is of first importance. It follows the flag and the fleet—locates the enemy—flashes urgent orders—safeguards the convoy—guides the bombers—directs the artillery—maneuvers the tank. This science fights on every front.

And when that certain day of Victory comes RCA Laboratories will be devoted to the happie task of making our peacetime world richer, safer more enjoyable and more productive—throug new and finer products of radio, television an electronic research.

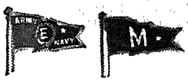
OTHER SERVICES OF RCA WHICH HAVE EARNED OUR COUNTRY'S HIGHEST WARTIME AWARDS



The Army-Navy "E" flag, with two stars, flies over the RCA Victor Division plant at Camden, New Jersey.



The Army-Navy "E" flag, with one star, has been presented to the RCA Victor Division at Harrison, New Jersey.



The Army-Navy "E" flag, with one star; also the U. S. Maritime Commission "M" Pennant and Victory Fleet Flag have been awarded to the Radiomarine Corporation of America in New York City.

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RCA

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